GENERAL REPORT
of the operations

SURVEY OF INDIA

~~1903-04~~.
1895-96 to 1897-98

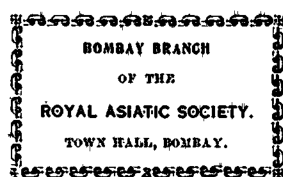

BOMBAY BRANCH
OF THE
ROYAL ASIATIC SOCIETY.
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Survey of India Offices, Calcutta, March 1897.

GENERAL REPORT

ON THE

OPERATIONS

OF THE

Survey of India Department.

ADMINISTERED UNDER

THE GOVERNMENT OF INDIA

DURING

1895-96. to 1897-98

PREPARED UNDER THE DIRECTION OF

MAJOR-GENERAL C. STRAHAN, R.E.,
SURVEYOR-GENERAL OF INDIA.





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TO THE

GREAT TRIGONOMETRICAL SURVEY

OF

INDIA



INDIA
SHOWING THE PROGRESS OF THE IMPERIAL SURVEYS
To 1st October 1896.
REFERENCES.
BAY OF BENGAL
INDIAN OCEAN
No. 371-S. 97.

GENERAL REPORT

ON THE

Operations of the Survey of India

DURING THE SURVEY YEAR

1895-96.

PART I.

SUMMARY.

ADMINISTRATION.

1. The operations of the department that are now reported on are for the survey year ending 30th September 1896.

2. The general administration of the department and the superintendence of the Topographical Branch remained in the hands of Colonel C. Strahan, R.E., Surveyor-General of India, throughout the year. At the commencement of the year the superintendence of the Revenue Branch and of the Bengal Survey Branch was in the hands of Colonel W. H. Wilkins, S.C., in the absence of Colonel J. E. Sandeman, S.C., on special leave, but the latter officer resumed the charge on his return to duty on the 28th October 1895 and retained it during the remainder of the year. Lieutenant-Colonel St. G. C. Gore, R.E., continued in the superintendence of the Trigonometrical Surveys, but proceeded on furlough for six months on the 26th March 1896; during his absence Captain S. G. Burrard, R.E., was appointed to officiate for him, but as he was unable to undertake the duties for two months, the Superintendent's work was performed by Mr. J. Eccles, M.A., during that period, and by Captain Burrard until the close of the year.

Inspection Tours of the Administrative Officers.

3. On the 18th April 1896 Colonel C. Strahan, R.E., left Calcutta for Naini Tal, where he visited the office of No. 8 Party which had just returned from the field, and also met Mr. Scott, who was in charge of the Land Records Surveys in the North-Western Provinces and Oudh, with whom he discussed the future survey operations in those Provinces. Details were left to be settled by Colonel Sandeman, the Deputy Surveyor-General, afterwards. From Naini Tal Colonel Strahan proceeded to Dehra, where he inspected the office of the Trigonometrical Branch, which was then under the superintendence of Mr. Eccles, during the absence of Lieutenant-Colonel Gore on furlough and Captain Burrard on examination leave. He also met the several Survey Officers at Mussoorie, but their offices had hardly commenced their recess work at that time.

On the 1st May he arrived at Simla, where he remained until the latter end of July, when he returned to Calcutta. During his stay at Simla he discussed the programme for the ensuing field season and other questions with the Government of India, and also inspected the office of No. 18 (Himalaya) Party and the Simla Drawing Office.

On the 26th August Colonel Strahan again left Calcutta on a lengthened tour, inspecting in turn the offices of Nos. 11, 20 and 21 Parties at Bangalore, and of Nos. 10, 17 and 25 Parties at Poona. While passing through Bombay he took the opportunity of visiting the self-recording magnetic instruments in the Meteorological Observatory there. From Bombay he visited Karachi,

where are the recess quarters of No. 12 Topographical Party; whilst there he discussed several questions relating to the survey of Sind with the Commissioner, besides carefully inspecting the office of the party. He next visited Quetta, where he inspected the work of No. 15 Party; his examination of the work of that party was, however, somewhat curtailed owing to illness and his inability to remain there after his recovery, as his presence was urgently required at Mussoorie, to settle with the Deputy Surveyor-General, Revenue Branch, certain questions regarding the programme of the parties in the North-Western Provinces. At the same time Colonel Strahan again visited Dehra, inspected the Survey School lately started there, and discussed various questions with Lieutenant-Colonel Gore, Superintendent of Trigonometrical Surveys, who had returned from furlough.

4. Colonel Sandeman, the Deputy Surveyor-General, Revenue Branch, left Calcutta on the 8th December 1895 on a tour of inspection in the North-Western Provinces and Oudh. On the 13th December he inspected No. 8 Traverse Party while at work in the Bahraich district, and on the following day he inspected the Land Records Survey which was being carried on in the same district under Mr. W. Skilling. He then proceeded to Shajahanpur where the field work of No. 2 Traverse Party, which had just been commenced, was thoroughly inspected on the 16th December and two following days. From the 19th to the 22nd December he was engaged in inspecting the traverse work of No. 8 Party in the Meerut district, and on the 23rd the Land Records Survey in the same district, under Mr. T. F. Freeman, Deputy Collector, was inspected. On the 11th January 1896, Colonel Sandeman left Calcutta for Burma, and from the 14th to the 21st January was occupied in a thorough examination of the field work of No. 7 Cadastral Party, under Mr. Gilbert-Cooper, in the Thaton and Pegu districts. From the 22nd to the 25th January, he inspected the work of No. 20 Forest Party in districts Shwegyin, Pegu and Toungoo. On the following day he proceeded to Upper Burma, and for the next month, up to the 26th February, was engaged in inspecting the field operations of No. 3 Cadastral Party in districts Yamethin, Shwebo, Katha, Upper Chindwin, Pakkoku and Myingyan. On the 29th February, at the conclusion of his tour in Burma, he made a thorough inspection of the Rangoon City Survey, which was being carried on by No. 7 Party.

On the 13th April, Colonel Sandeman visited Bihar, and remained there inspecting the Cadastral Surveys in the Muzaffarpur and Saran districts, under Nos. 4 and 5 Parties, until the 19th April. On the 25th May he arrived at Shillong and inspected the recess office of No. 6 Cadastral Party, which occupied him till the 5th June. He also discussed the future programme of No. 6 Party, in the event of its being decided that it should continue to work in Assam.

In September, Colonel Sandeman visited the North-Western Provinces Traverse and Bihar Cadastral Parties recessing at Naini Tal and Mussoorie. From the 11th to the 25th September he inspected the recess office of No. 8 Traverse Party at Naini Tal, and from the 28th September to the 10th October he inspected those of No. 2 Traverse and Nos. 4 and 5 Cadastral Parties, and of the Singhbhum and Palamau Traverse Detachments at Mussoorie. Whilst at Naini Tal he discussed with the Local Government the future requirements of the North-Western Provinces.

Early in December he visited Allahabad and again discussed the future requirements of the North-Western Provinces and Oudh with the Local Government. On the 11th December he proceeded to Gorakhpur where he met the Director of Land Records and Mr. G. B. Scott, Superintendent of Land Records Surveys.

5. Captain Burrard, while officiating as Superintendent, Trigonometrical Surveys, inspected, during July and August 1896, the recess offices of Nos. 14, 22, 23 and 24 Parties of the Trigonometrical Branch, located at Mussoorie. He also proceeded to Simla during August and inspected the recess office of No. 18 Party there.

FIELD PARTIES.

6. The field operations of the year under report were carried on by 21 parties (of which one was a double party) and two small detachments. Of these,

one party was employed on trigonometrical surveys; six parties on topographical surveys; four parties on forest surveys; four parties on cadastral surveys; three parties and two detachments on traverse surveys; and three parties on scientific operations. The operations of the Forest Survey Branch were also continued during the year. The Land Records Surveys carried on by local agency in the North-Western Provinces and Oudh, which are under the superintendence of the Deputy Surveyor-General, Revenue Branch, have also been included in this report under the head of Cadastral Surveys.

7. The following tabular statement shows collectively the whole of these operations grouped according to the scope and nature of the work on which the parties were severally employed :—

Statement of Survey Operations and Parties.

No. of Party.	Nature and *locale* of operations.	Page in this Report.	Executive Officers.	Scale of Survey.	Administrative Superintendent.
	Trigonometrical Survey.				
24	Baluchistan and Upper Burma.	15	Captain J. M. Burn, R.E.	......	Supdt., Trig.
	Topographical Surveys.				
10	Bombay	16	Lieutenant A. J. Pilcher, R.E. Mr. A. J. Gibson	2″=1 mile for reduction to half scale.	D. S. G., Rev.
11	Upper Burma	17	Captain T. F. B. Renny-Tailyour, R.E.	1″=1 mile for reproduction.	Ditto, Topo.
12	Sind	18	Captain G. B. Hodgson, S.C.	2″=1 mile and 1″=1 mile for reproduction.	Ditto, Topo.
15	Baluchistan	22	Mr. T. E. M. Claudius	2″=1 mile, ½″=1 mile, ¼″=1 mile and ⅛″=1 mile for reproduction.	Ditto, Topo.
18	Himalayas	24	Lieutenant-Colonel R. A. Wahab, R.E. Captain J. M. Fleming, S.C. Mr. C. D. Potter	4″=1 mile for reduction to ½ scale and reproduction, and 2″=1 mile for reproduction.	Supdt., Trig.
21	Upper Burma	26	Major F. B. Longe, R.E. Lieutenant C. L. Robertson, R.E. Mr. A. J. Wilson	1″=1 mile for reproduction.	D. S. G., Topo.
	Forest Surveys.				
14	Central Provinces	28	Major W. J. Bythell, R.E. Mr. C. F. Erskine	4″=1 mile for reproduction.	Suptd., Trig.
17	Bombay	31	Lieutenant-Colonel J. R. Hobday, S.C. Major W. J. Bythell, R.E.	16″=1 mile, 8″=1 mile and 4″=1 mile for reproduction.	D. S. G., Topo.
19	Madras	34	Lieutenant C. H. D. Ryder, R.E.	4″=1 mile for reproduction.	Ditto, Topo.
20	Burma	35	Captain P. J. Gordon, S.C.	4″=1 mile and 2″=1 mile for reproduction.	Ditto, Topo.
Forest Survey Branch.	Central Provinces	37	Mr. W. H. Reynolds	4″=1 mile for reproduction.	I. G., Forests.
	Oudh and North-Western Provinces.	38	Ditto	4″=1 mile and 1″=1 mile for reproduction.	Ditto.
	Punjab	40	Ditto	4″=1 mile for reproduction.	Ditto.
	Burma	40	Ditto	4″=1 mile for reproduction.	Ditto.
	Cadastral Surveys.				
3	Upper Burma	41	Mr. G. H. Cooke	16″=1 mile and 8″=1 mile for reproduction.	D. S. G., Rev.
4 & 5	Bihar	46	Lieutenant C. W. H. Symonds, S.C.	16″=1 mile for reproduction.	S. S. S., Bengal.
6	Assam	54	Mr. E. C. Barrett Mr. W. H. Penrose	16″=1 mile for reproduction.	D. S. G., Rev.
7	Lower Burma	56	Mr. C. Wood Mr. B. G. Gilbert-Cooper	16″=1 mile for reproduction.	Ditto, Rev.
Land Records Surveys.	North-Western Provinces and Oudh.	60	Mr. G. B. Scott	16″=1 mile for reproduction.	Ditto, Rev.

Statement of Survey Operations and Parties—contd.

No. of Party.	Nature and *locale* of operations.	Page in this Report.	Executive Officers.	Scale of Survey.	Administrative Superintendent.
	Traverse Surveys.				
2	North-Western Provinces and Oudh.	63	Captain J. M. Fleming, S.C. Mr. W. S. Buttress Mr. G. E. Parker	16"=1 mile (skeleton plots.	D. S. G. Rev.
8	North-Western Provinces and Oudh.	65	Mr. J. S. Pemberton	16"=1 mile (skeleton plots).	Ditto, Rev.
9	Central Provinces	67	Mr. E. J. Jackson	16"=1 mile (skeleton plots).	Ditto, Rev.
Det.	Singhbhum	69	Mr. J. P. Barker	16"=1 mile (skeleton plots).	S. S. S., Bengal.
Det.	Palamau	70	Mr. L. F. Berkeley	16"=1 mile.	Ditto ditto.
	Geodetic.				
22	India and Europe	71	Captain S. G. Burrard, R.E.	......	Supdt., Trig.
23	India and Europe	71	Captain G. P. Lenox-Conyngham, R.E.	......	Do, Trig.
	Tidal and Levelling Operations.				
25	India	74	Captain C. C. D. Morice, R.E.	......	Do., Trig.

OUTTURN.

8. During the year under report the aggregate area surveyed on all scales amounts to 63,653 square miles, of which 30,279 square miles were reconnaissance only. Last year's report shows an area of 125,384 square miles; the diminution this year is entirely due to the smaller amount of geographical reconnaissance that has been done, the aggregate area of rigorous survey on all scales amounting to 33,374 as against 32,750 square miles last year. These areas are exclusive of those embraced by the traverse operations in the Central Provinces and in the North-Western Provinces and Oudh, carried on for the purpose of furnishing a basis for field surveys under the Settlement Department, of which this year's area amounts to 8,719 square miles, whilst that of last year was only 5,018 square miles.

The operations of the various field parties will be found summarized in the following paragraphs, in the order in which they appear in the foregoing statement. A detailed report on the operations of each party for the year under review is given in Part II.

TRIGONOMETRICAL SURVEYS.

9. Principal triangulation was executed during the year both in Upper Burma and in Baluchistan. In the former the series which is to connect the Mandalay Meridional Series with the Assam triangulation was continued. One figure, covering a direct distance of 18 miles, and comprising an area of 360 square miles, was completed, and a portion of the observations, required to carry the work over the flat forest-clad valley of the Chindwin, were also successfully accomplished. Contrary to expectation, the connection between the Burma and Assam triangulation was not completed owing to the hazy state of the atmosphere and the very difficult nature of the country.

In Baluchistan a commencement was made with the Principal longitudinal series, sanctioned by Government, which, starting from the Great Indus Series, is to be pushed westwards through Baluchistan. Its immediate object is to afford a sound and accurate basis for the mass of secondary triangulation which has been, from time to time, executed in Baluchistan and Makrán, and which has hitherto greatly needed strengthening by a thoroughly accurate system of triangulation. It will in all probability also form the commencement of a series which will at some future time doubtless link up the trigonometrical systems of Europe and Asia.

This series, in latitude 26°, emanating from a side of the Great Indus Series on the meridian 67° 15′, was commenced and extended westwards into Las Beyla territory for a direct distance of 50 miles, comprising three figures, covering an area of 1,146 square miles.

Astronomical observations for azimuth were taken at two stations, one in Baluchistan and one in Burma.

TOPOGRAPHICAL SURVEYS.

10. During the year under review six parties have been engaged on topographical operations, *viz.*, No. 10 in the Southern Maratha country, Bombay; No. 12 in Sind; No. 15 in Baluchistan; No. 18 in the Himalayas, and Nos. 11 and 21 in Upper Burma.

11. No. 10 Party brought to completion the 2-inch survey of the Southern Maratha country upon which it has been engaged during the past nine seasons. The area surveyed during the season was 1,757·5 square miles and the cost-rate per square mile R20·5. At the close of the year the party was transferred to Burma for employment on the topographical survey of the Shan States on the 1-inch scale, in conjunction with Nos. 11 and 21 Parties.

No. 12 Party, which had been previously employed on cadastral surveys in Upper Burma, was transferred at the commencement of the season to the Bombay Presidency and undertook the topographical survey of the Sind Province. The area surveyed amounted to 1,241 square miles on the 2-inch scale and 677 square miles on the 1-inch scale. The cost-rates are, for the former area R24·9 and for the latter R10·4 per square mile. The rate for the 2-inch work is somewhat higher than may be expected in future, owing to the large area of coast land surveyed this season, which involved the maintenance of a fleet of boats.

No. 18 Party completed a total are of 817 square miles in the Himalayas, of which 88 square miles were surveyed on the 1-inch scale, 316 square miles on the 2-inch, and 413 square miles on the 4-inch scale. The 1-inch work lay in Chota Bangahal, Kangra district; the 2-inch work comprised areas in Mandi and Suket Native States and the Simla hill States, and the 4-inch survey consisted of topography in Kangra and Kullu and the forests of the Native States of Patiala and Sirmur. The cost-rates of the 4-inch and 2-inch surveys are R85·5 and R49·1 per square mile respectively, or R1·8 and R3·6 per square mile less than the average of the past nine years.

Nos. 11 and 21 Parties continued the topographical survey of the Shan States, Upper Burma, on the 1-inch scale, No. 11 Party contributing 1,355 square miles and No. 21 Party, 937 square miles. The latter party also accomplished an area of 5,079 square miles of geographical survey on the ¼-inch scale.

Small areas were also topographically surveyed on the 2-inch and 1-inch scales in district Thaton, Lower Burma, by No. 7 Cadastral Party and by the Forest Branch in the Punjab.

12. The areas topographically surveyed on various scales during the year amount to 19,798 square miles, against 21,588 square miles executed in the previous year.

The total is made up as follows:—

11,307	square	miles	surveyed	on the	¼-inch	scale.
4,014	,,	,,	,,	,,	1-inch	,,
4,244	,,	,,	,,	,,	2-inch	,,
213	,,	,,	,,	,,	4-inch	,,
20	,,	,,	,,	,,	8-inch	,,

FOREST SURVEYS.

13. Forest survey operations were continued by the four parties previously employed on this class of surveys in the Central Provinces, the Bombay and Madras Presidencies and in Lower Burma; and by the Forest Survey Branch in the Central Provinces, the North-Western Provinces and Oudh, the Punjab and in Upper and Lower Burma. A small area of forest lands was also surveyed by the party working in the Himalayas.

14. In the Central Provinces, the detail survey of the forests in the Betul district, as allotted to No. 14 Party, was brought to a close. Operations were

also carried on in the Damoh district. The total outturn was 650·6 square miles, or 432·9 square miles in Betul and 217·7 square miles in Damoh. The usual classification of forest growth and soils was carried out over the areas surveyed in detail. Triangulation and traversing in advance of topography were carried on in the Damoh and Bilaspur districts, covering an area of 1,165 square miles, of which, however, only 850 square miles will be surveyed in detail. The amount of traversing in advance of topography consists of 1,232 linear miles. The cost-rate per square mile of the detail survey is R81·2.

15. In the Bombay Presidency, forest surveys were continued, comprising detail surveys on the 8-inch scale in the Thana district, Northern Circle; on the 4-inch, 8-inch and 16-inch scales in the Poona district, Central Circle; and on the 4-inch scale in the North Kanara district, Southern Circle. The areas surveyed amounted to 952 square miles, of which 829 were on the 4-inch, 108 on the 8-inch and 15 on the 16-inch scale. The total area surveyed last year was 468 square miles. The area triangulated in advance was 505 square miles, and the area traversed was 344 square miles. The cost-rates, with the exception of that of the 16-inch work, show a considerable decrease on those of last year, and can hardly be expected to be still further reduced.

16. In the Madras Presidency, the survey of forest reserves was continued in the Salem, North Arcot and Kurnool districts, the area surveyed in detail on the 4-inch scale amounting to 964 square miles, or 9 square miles less than last year. The cost-rate per square mile has been slightly reduced. The area of advance triangulation was 1,815 square miles, and 820 linear miles of forest boundaries were traversed.

17. In Lower Burma, the survey of forest reserves in the Toungoo and Pegu districts was continued on the 4-inch scale, the unreserved forests in the former district being surveyed on the 2-inch scale. The outturn amounted to 339 square miles on the 4-inch and 111 on the 2-inch scale, or a total of 450 square miles, as against 375 square miles last year. The cost-rate of the combined operations is considerably lower than last year.

18. The party working in the Himalayas surveyed an area of 200 square miles on the 4-inch scale of forest blocks in Kullu and Kangra and the native states of Patiala and Sirmur.

19. The Forest Survey Branch continued the operations of previous years in six districts of the Central Provinces; in three districts of the North-Western Provinces and Oudh; in the Chamba State, Punjab; in the Pyinmana forests, Upper Burma, and in those of the Attaran Valley, Lower Burma. The aggregate area surveyed amounts to 2,333 square miles, of which 621 were on the 1-inch scale (for purely topographical purposes, and returned under the head of Topographical Surveys), and 1,712 on the 4-inch scale. This area is 435 square miles in excess of last year.

20. The total outturn of forest surveys executed on various scales during the year amounts to 4,914 square miles, of which 1,712 square miles was surveyed by the Forest Survey Branch. The area surveyed by the Imperial survey parties, *viz.*, 3,202 square miles, is 590 square miles in excess of that surveyed in the previous year by the same parties.

The areas on the different scales are as follows:—

111	square miles surveyed on the 2-inch scale.
4,695	" " " " 4-inch "
108	" " " " 8-inch. "

CADASTRAL SURVEYS.

21. The number of parties engaged on cadastral operations during the year has been as follows:—One double party in Bihar, two parties in Burma, and one party in Assam. In addition to the operations of the Imperial parties land records cadastral surveys have been carried on by local agency in various districts in the North-Western Provinces and Oudh, and as these operations are under the professional control of the Deputy Surveyor-General, Revenue Branch, they will in future be included in this Report.

22. In Bihar, the double party was engaged, in continuation of the operations of the previous season, in the cadastral survey and preparation of the record-of-rights in the districts of Saran, Champaran, Muzaffarpur and

Darbhanga, and in the Government and Tikari Wards' Estates in districts Gaya and Patna. It also commenced new surveys in the Narhan Wards' Estate, district Monghyr.

23. The following is a summary of the progress of work in each district:—

In Saran, an area of 645 square miles was cadastrally surveyed, and the records were written of an area of 669 square miles, the cost-rates being R71 per square mile for cadastral survey and R76·2 for the records. The area remaining to be cadastrally surveyed in this district amounts to 1,425 square miles, of which 1,197 square miles have been traversed in advance.

In Champaran, an area of 1,185 square miles was completed in cadastral survey and record-writing, and the cost-rates per square mile were R56·5 for the survey and R47·4 for the records. With the exception of about 290 square miles in the north of the district, which was not allotted for survey, the Champaran district has now been completed in all respects.

In Muzaffarpur, the area of cadastral survey and record-writing amounted to 431 square miles, which completes the operations in that district also. The cost-rates per square mile were, for the survey, R85·2, and for the records, R87. In addition to the regular cadastral operations, small areas previously surveyed by Colonel Barron and Mr. Finucane, respectively, were revised, and further small areas were cadastrally surveyed in Hajipur, at the request of the Settlement Officer, and in the Sabalpur Estate, districts Patna and Muzaffarpur, making the total area cadastrally surveyed 459 square miles. Surveys of the Lalganj and Sitamarhi Municipalities were also made.

In Darbhanga, the operations were almost entirely confined to traverse survey, under which head an area of 1,179 square miles was completed. Owing to the late receipt of plots, very little cadastral survey could be done, the area completed in survey and record-writing amounting to 16 square miles.

In Gaya, the survey of the Government Estates was continued and brought to completion with an area of 15 square miles of traverse, cadastral survey and record-writing. The cost-rates were, for survey, R39·7, and for the records, R36·3, per square mile.

In the Belkhara Estate, Gaya and Patna districts, an area of 14 square miles was cadastrally surveyed, and the records of an area of 17 square miles were written. A large portion of the Estate had already been surveyed on the 32-inch scale in 1875-76, and the maps of 31 square miles, and the records of 62 square miles, of this portion were revised during the season. This completes the survey and record-writing of the Tikari Wards' Estates.

In the Narhan Wards' Estate, district Monghyr, the cadastral survey was commenced of villages in which the Estate owned a half share or more. The area surveyed was 54 square miles, and the records of 47 square miles were written.

In addition to the above operations, this party undertook the survey of disputed boundaries between the villages of Tintanga and Buddhu Chuk, district Bhagalpur, at the instance of the Collector, and completed it.

24. The two parties which continued cadastral operations in Burma, were No. 3 Party, working in Upper Burma, and No. 7 Party in Lower Burma.

25. In Upper Burma, the operations of No. 3 Party were scattered over five districts. The areas cadastrally surveyed were, in Myingyan, 1,187 square miles; in Yamethin, 452; in Shwebo, 193; in Katha, 142, and in Upper Chindwin, 32, or a total area of 2,006 square miles surveyed on the 16-inch scale. In Upper Chindwin an area of 101 square miles previously surveyed was revised in addition to the above. In Katha an area of 2 square miles of gold-mining grants was surveyed on the 8-inch scale. The cost-rates per square mile of the 16-inch work were, in Myingyan, R82·9; in Yamethin, R62·5; in Shwebo, R92·3; in Katha, R72·0; and in Upper Chindwin, R134·1.

26. No. 7 Party, working in Lower Burma, completed the cadastral survey of an area of 596 square miles, of which 491 lay in the Pegu district and 105 in the Thaton district. It also traversed an area of 714 square miles in advance in the former district. The cost-rates of the cadastral survey were, for the Pegu district, R116·1 and for Thaton, R159·7 per square mile. The gardens and cultivated areas scattered in the hilly parts of Thaton district were topographically surveyed; the outturn of this work amounted to 228 square miles on the 2-inch scale and 336 square miles on the 1-inch scale, which areas have

been returned under the head of Topographical Surveys. The survey of the Rangoon town, part on the scale of 50 feet and part on 100 feet to one inch, was also commenced during the season by this party. The total area of the town is about 12 square miles, of which nearly 7 square miles were completed on the two scales.

27. In Assam, No. 6 Party continued the traverse and cadastral survey of district Cachar, and completed an area of 349 square miles, at a cost-rate of R100·1 per square mile. The cost-rate of the combined operations, including traversing, detail survey, statistics and completion of records, was R 217·4, which is a considerably higher rate than last year owing to the smaller area surveyed. The above area practically completes the cadastral survey of the Cachar district; but there still remains a considerable amount of traversing in temporarily settled estates in Sylhet, in the extension surveys made by Settlement Officers, and in outlying tea-grants, besides the topographical survey of gaps between the areas surveyed cadastrally, and the revision of the past season's work. This, if sanctioned, will provide work for the party for the next two seasons.

28. In the North-Western Provinces and Oudh, land record surveys have been in progress in seven districts during the past two seasons. These surveys are under the executive control of Mr. G. B. Scott, subject to the supervision of the Deputy Surveyor-General, and they are carried out entirely by *patwári* agency. The work in each district is superintended by an officer of the Provincial Service of the Imperial Survey. The total area surveyed up to date is 5,870 square miles, of which 3,269 square miles were completed during the year under review. The record-writing of 5,305 square miles, or nearly the whole area surveyed, was performed during the year.

29. The areas cadastrally surveyed during the year in the different Provinces are as follows:—

	Square miles.
Bihar	2,388
Burma	2,603
Assam	349
North-Western Provinces and Oudh	3,269
TOTAL	8,609

TRAVERSE SURVEYS.

30. Three parties were employed during the year on these surveys, the object of which is to furnish a skeleton basis for settlement surveys by local agency. Traverse operations were also carried on by two small detachments in Government estates in Chota Nagpur, in one case with the above object and in the other in order to lay down the external boundaries of certain villages which were not required to be cadastrally surveyed.

31. In the North-Western Provinces and Oudh, two parties, Nos. 2 and 8, were employed on traverse operations. The former completed an area of 2,447 square miles, of which 1,501 were in the Shahjahanpur district and 946 in the Kheri district. The cost-rates per square mile were R25·3 and R28·2 respectively. No. 8 Party was employed in the Meerut, Bareilly, Sitapur and Bahraich districts, in which the areas traversed were 492, 841, 216 and 1,394 square miles, respectively, or a total of 2,943 square miles. The cost-rates were R24·7 per square mile for the traversing in Meerut and Bareilly, and R19·9 for that in Bahraich and Sitapur.

32. In the Central Provinces, No. 9 Party continued the operations of previous seasons and was employed in the Sambalpur, Bilaspur, Raipur, Chanda and Chhindwara districts. The total area traversed was 3,329 square miles, of which 395 lay in Sambalpur, 1,110 in Bilaspur, 923 in Raipur, 507 in Chanda, and 394 in Chhindwara. The cost-rate of the traversing was R22·5 per square mile. As the traverse operations in the Central Provinces are now completed, this party has been transferred to the Madras Presidency to undertake forest surveys in conjunction with No. 19 Party.

33. Of the two detachments, one was employed in the Palamau Government Estate, and the other in the Kolhan Government Estate, Singhbhum district. The object of the former was to lay down such portions of the external

boundaries of the *khalsa mauzas* (revenue-paying villages) belonging to the estate as hadnot been surveyed cadastrally in accordance with the old Revenue Survey maps. The area traversed amounted to 141 square miles. The Singhbhum detachment continued the operations of the previous season, which consisted of traverse survey only, as the cadastral survey is being undertaken by local agency. The area traversed amounted to 229 square miles.

34. The areas traversed during the year, exclusive of the preliminary traversing connected with the cadastral surveys made by this Department, are as follows :—

	Square miles.
North-Western Provinces and Oudh	5,390
Central Provinces	3,329
Bengal	370
TOTAL	9,089

SPECIAL OPERATIONS.

35. The operations for the telegraphic determination of the difference of longitude between Karachi and Greenwich, the commencement of which was alluded to in last year's Report, have been brought to a very successful conclusion. Captains Burrard and Lenox-Conyngham continued the work they had begun, and the arcs Potsdam-Teheran and Teheran-Bushire were measured. Great difficulties were experienced owing to the immense length of line worked through, and to very unpropitious weather. The work has, however, been completed most satisfactorily and the subsequent reductions finished. The final value of the longitude of Madras is $5^h\ 20^m\ 59^s.113$; this value is $0^s.308$ less than that which has been hitherto regarded as the most accurate available. It is equivalent to $4''\cdot62$ of arc, or about 150 yards in linear measurement.

36. The tidal observations have been continued as usual. Observations with the self-registering tide-gauges have been made at 13 stations in India, Burma, the Persian Gulf, Ceylon, the Andaman Islands and Minicoy. The tidal observations at Minicoy and Trincomalee were closed during the year. A new tidal observatory was erected at Suez, and it will be fitted up and started during the ensuing year.

37. In connection with the tidal operations, spirit-levelling was carried on from Raipur, on the Bombay False-Point line, southwards *viâ* Dhamtari and Jeypur and over the Jubilee Ghat along the Itikivalasa-Koraput road to Potangi, where it had to be stopped, about 60 miles short of the proposed closing point at Vizagapatam, owing to the complete break down of the health of the whole party. The total outturn amounts to 278·5 miles of double levelling, fixing 24 embedded and 162 ordinary or inscribed bench-marks, and 4 stations of the Great Trigonometrical Survey.

GEOGRAPHICAL SURVEYS AND RECONNAISSANCES.

38. In Upper Burma an area of 5,079 square miles of new country was geographically surveyed on the ¼-inch scale by surveyors of No. 21 Party.

39. The aggregate areas geographically surveyed during the year on the Eastern and Western Frontiers amount to 30,279 square miles.

HEAD-QUARTERS OFFICES.

40. The details of the work done at the various offices at the head-quarters are given in Part III of this Report.

41. The offices located in Calcutta were, as usual, supervised by three Assistant Surveyor-Generals. The Drawing and Engraving Offices remained in the charge of Mr. C. F. Erskine until the 8th May 1896, when he was relieved by Mr. A. E. Spring, who held it during the remainder of the year. As a matter of administrative convenience, the Bengal Provincial Drawing Office was placed under the charge of the Assistant Surveyor-General at the commencement of the year. The Photographic and Lithographic Office continued under the supervision of Colonel J. Waterhouse, S.C., and the Correspondence and

Mathematical Instrument Offices under that of Colonel M. W. Rogers, R.E., throughout the year.

42. In the Drawing Office, the Geographical Section has been engaged chiefly with the production of the maps of Burma. Of the twelve sheets of the North-East and South-East Frontier series, which have been in hand during the year, two (sheets Nos. 15 North-West of the North-East Frontier Series and 2 North-West of the South-East Frontier Series) have been published, and two (sheets Nos. 3 South-East and 3A North-East of the South-East Frontier Series), all on the scale of 1 inch=4 miles, are still in hand. Of the sheets on the 8-mile scale of the same series, five (sheets Nos. 23 of the North-East Frontier Series and 1, 4, 5 and 6 of the South-East Frontier Series) are still in hand; two, (sheets Nos. 9 and 10 of the South-East Frontier Series) are in course of publication, and one (sheet No. 13 of the South-East Frontier Series) has been published. The more important general maps dealt with during the year were the canal map of India on the 32 mile scale, and the new engraved map of India on the 128-mile scale. The third edition of the 32-mile map of India still awaits the orders of the Government of India with regard to the frontier boundaries. All the 16-mile provincial maps have been brought up to date in respect of railways, boundaries and principal roads; and 66 sheets of the Atlas of India have been similarly corrected. Seventy-five sheets of the same atlas received additions to details and five sheets were improved as regards hill-shading. Forty-six sheets of the Central India and Rajputana survey, on the 1-inch scale, have also been in various stages of progress with a view to their completion to margin.

The principal work of the Revenue Section consisted in the drawing of five standard sheets of Burma and Bengal on the 2-inch scale; of the map of Calcutta and Suburbs, in four sections, on the 3-inch scale; of the 1-inch map of Calcutta and surrounding country; and of the map of the Hooghly river, in two sections, on the 6-inch scale. These maps of the Suburbs and country round Calcutta are based on very old maps supplemented by the addition of new roads and the more important buildings sketched in on a plane-table by a native surveyor. A new survey of the Suburbs on a large scale similar to that already completed of the town and a good topographical survey of the surrounding country is much wanted. A good survey of the banks of the Hooghly River has been made within the last fifteen years. Maps of Cawnpore and Basiratganj, showing British positions and military operations during the mutiny of 1857 and 1858, were also prepared. During the year, 49 fair standard sheets on the 1-inch scale, and 8 on the 2-inch scale, of the Punjab, North-Western Provinces, Bengal, Bombay and Burma, received from survey parties; 40 sheets of the Moulmein town, 2 of Dharwar town and 5 of Naini Tal, were finally examined, corrected and rendered suitable for photography. Of the old maps, 54 *pargana* or main circuit maps of Shahabad, Gaya, Manbhum, Backerganj and Hoshangabad were also touched up, corrected and brought up to date for publication.

In the Cadastral Section, 7,131 cadastral sheets were prepared for publication, of which 2,503 belonged to the North-Western Provinces, 3,542 to Burma, and 86 to Orissa.

The Bengal Drawing Section continued to be employed on the compilation of standard quarter-sheets on the 2-inch scale from the maps of the cadastral parties employed in Orissa and Bihar. Forty-four standard quarter-sheets of Orissa were sent to the Photo-litho Office for reduction to the 1-inch scale, and unpublished proofs were sent to the local authorities for scrutiny. The mapping of the Bihar standard sheets, which was in abeyance owing to the field parties being unable to supply maps, was resumed late in the year. A special publication of certain Orissa standard maps on the 2-inch scale was also in progress for the Irrigation Department of Bengal.

43. In the Engraving Office, the preparation of the quarter-sheets of the Atlas of India was steadily pushed on, 6 new plates having been completed during the year; 47 others were in various stages of progress, and 86 published plates were added to and corrected. Eighteen district maps for administration reports were completed, and 37 others were in hand. The plan of the City of Calcutta, on the 16-inch scale, in 9 sheets, has been published, and also the 128-mile map of India, and the 16-mile map of Gujarat, both in outline only. Among other work completed is the 80-mile railway map of India, a section

plate, and three brass plates with inscriptions for the standard bench-marks of Calcutta. Of provincial maps, on the 16-mile scale, the outline of a new map of Bengal in two sheets was commenced. The writing of the maps of the Bombay and Madras Presidencies has made good progress, and the hills of the map of Mysore and Coorg have been in hand. The Punjab map in four sheets has been thoroughly brought up to date and is nearly ready for publication in outline and writing.

44. In the Photographic and Lithographic Office the work generally shows a satisfactory increase in almost all items. The total number of original maps and drawings in hand was 7,020, of which 686 were departmental, 4,874 cadastral maps of the North-Western Provinces and Burma, and 934 were miscellaneous subjects from other departments. In the latter class the work shows a very considerable increase and the total value of it was R86,364-6-6 or R9,829-11-6 more than last year.

The total outturn of the lithographic and zincographic presses and machines was 862,623 pulls and 948,057 copies. The number of pulls is 31,663 less than last year, partly owing to a breakdown of one of the large lithographic printing machines and also to a falling off in the outturn of the cadastral maps, but the number of copies or impressions printed was 26,215 more and the work on the whole was well up to the average.

The outturn of the type press also increased and comprised 668,795 copies from 11,915 items. The number of silver and blue prints was 3,069 or rather less than last year. The heliogravure work shows a very considerable increase. One hundred and forty-four plates were photo-etched and 56,288 impressions printed; 17 plates were electrotyped as matrices or duplicates. The total value of the work done in all sections was R2,19,778, or R12,582 more than last year.

The work has been of the usual miscellaneous character and there have been no important new departmental publications during the year. The skeleton map of the Punjab on the scale of 1 inch = 32 miles has been re-issued with corrections, also the map of the Punjab and Kashmir on the scale of 1 inch = 16 miles with the hills printed in brown. Two more of the series of district maps of the North-Western Provinces on the scale of 1 inch = 2 miles have been printed off, *viz.*, districts Mirzapur and Naini Tal, and district Garhwal is in hand. Eleven of the series of district maps of the scale of 1 inch = 4 miles based on the engraved Atlas sheets have been issued, including Cuttack (2nd edition), Hazaribagh, Howrah, Jessore, Khulna, Muzaffarpur, Noakhali, Nowgong, Puri, Raipur and Rangpur, and eight were in hand. One hundred and twenty-two sheets of standard maps of the Topographical and Revenue surveys on various scales have been issued. The map of Calcutta and environs on the scale of 3 inches = 1 mile was completed and issued, also maps of Naini Tal on the scale of 40-inches = 1 mile; a map of Dharwar city and environs was in hand. Thirty-two sheets of the Madras Forest Surveys on the scale of 4 inches = 1 mile were printed off.

The extra-departmental work continues to show a steady increase. One hundred and three plates illustrating Dr. Führer's report on the Great Jaina Stupa at Mathura, and 102 plates for Part II of Mr. E. W. Smith's report on Fatehpur Sikri were printed off and the plates for Part III were taken in hand. Two important new railway maps were lithographed in colours, illustrating the distribution of railways in India in relation to population and annual rainfall, and two geographical maps of Naini Tal and of district Bellary were in hand. A very large amount of work has again been done for the Meteorological Department. Forty plates of the survey of Penang and Province Wellesley were printed for the administration of the Straits Settlements and 74 plates of maps in English and Siamese, including 31 reprints for the Royal Survey Office of the Siamese Government.

The outturn of the Heliogravure Section shows a large increase. One hundred and forty-four plates were photo-etched, including 12 plates of the Technical Art Series for 1895 printed off, 15 plates for 1896 photo-etched, and 6 printed off. Twelve plates of fishes and crustacea illustrating the zoology of the Royal Indian Marine steamer *Investigator* were photo-etched and printed; 26 plates illustrating a report on the Chin Hills were photo-etched and printed; 27 plates of views illustrating the report of the Pamir Boundary Commission were photo-etched, also 12 plates of views of Lucknow during the mutiny for Mr. Forrest's new work. Two plates illustrating the action of cobra venom upon the blood have been etched

and printed in 3 colours very successfully. The demands upon the office for this kind of work are rapidly increasing as the value of the process becomes known.

As Colonel Waterhouse will be leaving the office during the year, he has recorded his high sense of the obligation he has been under during the 30 years of his charge to his staff of assistants, both European and native, who have always zealously seconded him in his efforts to carry on the work of the office and meet the heavy demands upon it.

45. In the Map Record and Issue Office the number of new maps and editions of departmental subjects received during the year amounted to 5,444, of which 5,054 were cadastral maps. The total number of maps issued was 200,416 and their value R1,06,702. The issues were less in number than those of the preceding year by 33,810, which is due to smaller demands by Government officials, and their value was less by R4,254. The cash sales of maps amounted to R23,507 in value, or an increase of R168 over those of the previous year.

46. In the Mathematical Instrument Office there has been a considerable increase in the demands for instruments over those of the preceding year. The total number of instruments issued was 96,673, against 71,875 last year. The value of these issues was R3,54,890, against R2,40,818 last year, an increase of R1,14,072. The outturn of repairs was also greater than in any previous year. The number of serviceable instruments received into store was 89,022, valued at R2,88,055; that of repairable instruments was 11,574, and their value R77,323.

The chief event of the year was the assembling of a Committee to report on the repairable stock of the office. The result of its recommendations was the grant of an extra temporary establishment to repair and convert the theodolites in store, and they further recommended that a large number of old and obsolete instruments should be broken up or sold. As a result of the various small extra establishments which have been sanctioned by Government from time to time during the past few years, for the purpose of converting and repairing obsolete levels and theodolites, it may be mentioned that no levels have been indented for from England since 1894, and no theodolites since 1895. The value of the English indents has accordingly been enormously reduced, having fallen from £13,000 in 1893-95 to £5,000 in 1896-97.

47. In the Trigonometrical Branch Office, Dehra Dun, the alterations to the office buildings, referred to in last year's Report, were completed during the year, and the accommodation is now sufficient for present requirements. A second edition of the Hand-book of Instructions for the Topographical Branch was prepared and was nearly ready for publication at the close of the year. The experiments to test the change in value of micrometer screws were continued with satisfactory results, and a complete set of magnetic observations was taken, which will be continued at stated intervals, and a pamphlet dealing with the subject was compiled for the use of observers. The computations for the synoptical volume of the North-East Longitudinal Series were proceeded with, and a large amount of other computation work was done. The usual meteorological and solar photographic observations were continued, and the Drawing and Photo-zincographic Sections were kept fully employed during the year.

A school for the training of sub-surveyors was started in May 1896, in which eight pupils were instructed during the year. It is hoped that its scope will shortly be considerably extended.

48. The Forest Survey Branch Office at Dehra Dun was engaged as usual during the year upon the final computations of the various field detachments; on the maintenance of the map records of the various provinces; on the compilation and drawing of special maps for the Forest Department; and on the training of surveyors in work. Thirty two special maps on various scales were published and 15 others were in progress; and 105 4-inch standard sheets of forest areas surveyed by the branch were published, 72 were sent to press and 132 were in progress. In addition, a considerable amount of colouring, tracing, and other miscellaneous work for forest and district officers was performed.

ESTABLISHMENT.

49. During the year the Department has lost the services of five officers of the Imperial list.

Colonel W. H. Wilkins, S.C., Superintendent, 1st grade, retired on the 12th December 1895, after having served in the Department for 32 years. He was principally engaged on the Revenue survey operations in the North-Western Provinces, Central Provinces, Bengal and Burma. During the last five years of his service he was attached to the head-quarters office, Calcutta, as Assistant Surveyor-General, and Officiating Deputy Surveyor-General, Revenue Branch. Colonel Wilkins had had great experience in revenue surveying in all its branches, including cadastral work, and the Department sustains a loss on his retirement.

Colonel J. Hill, R.E., Superintendent, 2nd grade, retired on the 25th December 1895, on superannuation. He joined the Trigonometrical Branch of the Department in December 1866, and had thus served for a period of 29 years, during which he was engaged on operations including trigonometrical, topographical and revenue surveys. For the last ten years, except when absent on furlough. he held charge of the tidal and levelling operations, which he conducted with remarkable zeal and ability. His retirement is a serious loss to the Department.

Colonel J. R. Wilmer, S.C., Superintendent, 2nd grade, retired on the 21st January 1896, after a service of twenty-six years and a half in the Department. He joined the Topographical Branch in August 1896, and during the whole of his service, with the exception of two months spent at head-quarters in 1892, he was engaged on topographical survey operations in Bundelkhand, Bhopal, the North-Western Provinces and Baluchistan, and on forest survey operations in the Central Provinces. Colonel Wilmer was a first-rate topographical officer, and he rendered valuable service in that branch of the Department.

Captain H. M. Jackson, R.E., Deputy Superintendent, 1st grade, reverted to the Imperial establishment on the 17th December 1895. He joined the Department in June 1883, and was employed principally on topographical survey operations in Baluchistan, Mysore and Burma. He was an able and energetic officer and an excellent draftsman, and the loss of his services is greatly regretted.

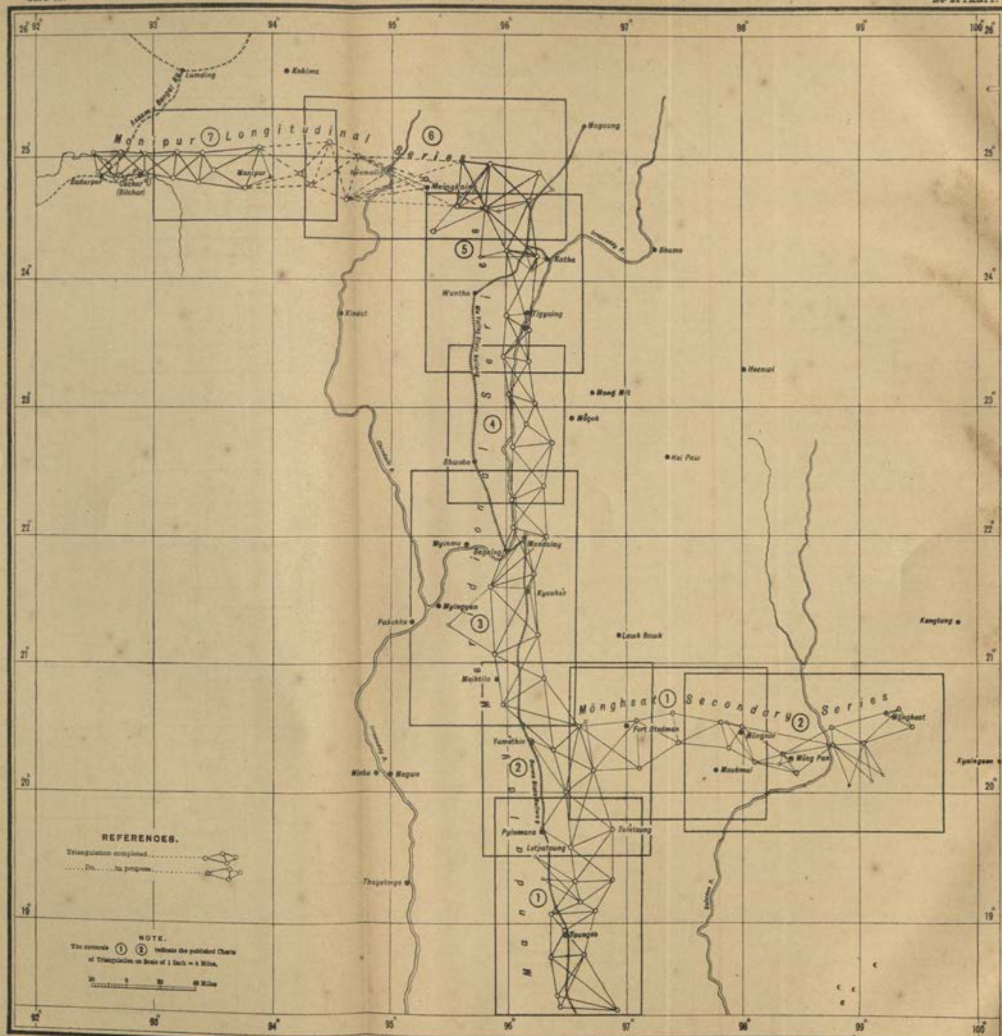
Mr. C. Wood, Deputy Superintendent, 2nd grade, died at Sagaing on the 22nd January 1896, while on furlough. He joined the junior division of this Department in May 1858. During the first 30 years of his service he was attached to the Computing Office of the Trigonometrical Branch, except for a short period when he was employed in Umballa and Kashmir. In 1889 he was placed in charge of the tidal and levelling operations. From December 1890 to December 1895, when he was forced to take furlough on account of ill-health, he held charge of cadastral survey operations in Lower Burma, where he did first-rate work, notwithstanding the many years he had spent in the Computing Office at Dehra, where he had no chance of making himself familiar with cadastral operations. He was much respected by all with whom he came in contact.

50. Eight vacancies have occurred in the Provincial list during the year, *viz.*, one by the retirement of Mr. S. M. Smylie, two by the deaths of Messrs. N. C. Gwynne and M. F. Berkeley, and five by the deputation of officers to the Provincial services of the North-Western Provinces and Burma.

INDEX TO THE CHARTS OF THE PRINCIPAL TRIANGULATION OF THE MANDALAY MERIDIONAL AND MANIPUR LONGITUDINAL SERIES.

1895-96.

No. 24 PARTY.



Reg. No. 426, S. I. D.—Sep. 96.—360.

Photo., S. I. O., Calcutta.

No. 425-S. 96.

PART II.

THE OPERATIONS OF THE SEVERAL FIELD PARTIES.

TRIGONOMETRICAL SURVEYS.

PRINCIPAL AND SECONDARY TRIANGULATION,

BALUCHISTAN AND UPPER BURMA.

NO. 24 PARTY.

Personnel.

Captain J. M. Burn, R.E., Officiating Deputy Superintendent, 2nd grade, in charge.
Lieutenant H.A.D. Fraser, R.E., Officiating Deputy Superintendent, 2nd grade.
Mr. J. Hickie, Extra Assistant Superintendent, 5th grade.
Mr. P. F. Prunty, Extra Assistant Superintendent, 6th grade.

51. This party, under Lieutenant Burn, R.E., was divided into two main sections, the one under him working on the Makrán Coast, and the other under Lieutenant Fraser in Upper Burma.

52. The first section, under Lieutenant Burn, commenced the Makrán Longitudinal Series, starting from the two stations Sulimani and Andar, of the Great Indus Series. The series was carried due west some 50 miles, and the position of the important town of Las Bela was definitely fixed.

53. The second section, under Lieutenant Fraser, re-observed some of the angles of the most northern figure of the Mandalay Meridional Series, and completed the most eastern of the figures of the Manipur Longitudinal Series.

Most unfavourable weather throughout the whole season, and the absolutely dense nature of the whole of the surrounding country, again seriously interfered with the progress of the work, and hence a most difficult figure is still left to carry the triangulation across the Chindwin Valley.

54. The season's outturn of the two sections is as follows:—

Horizontal and vertical angles have been taken at 14 principal stations. The principal series have been extended over a direct distance of about 70 miles, embracing an area of 1,506 square miles. Horizontal and vertical angles have been taken at four secondary stations, embracing an area of 500 square miles. Astronomical observations for azimuth were taken at two stations.

55. The principal observations were taken with Troughton and Simms' 12-inch micrometer theodolites, Nos. 1 and 2, Lieutenant Burn using No. 1. Lieutenant Burn's method of observing was to measure angles on 9 zeros, two faces on each zero, and two swings on each face. Owing, however, to the larger graduation errors of No. 2 instrument, Lieutenant Fraser observed on 12 zeros. The mean combined triangular error which ranged from 0·122″ to 1·168″ is 0·46.″

56. The section under Lieutenant Burn, working practically the whole season in the Las Bela State, was considerably hampered in its work by the unfortunate and untimely death of the Jam Sahib of Las Bela in the middle of January. Immediately after his death the country became somewhat disturbed, and the section was for a time in rather a precarious condition. By the use of a considerable amount of tact, however, and by the careful avoidance of anything in the shape of interference in political matters, the section was not seriously interfered with.

57. An untoward accident to Lieutenant Fraser's instrument, early in April, brought his work to a premature close. A sudden gale arose one night, and the observatory tent, with the instrument inside it, was blown down. The instrument has had to be sent to England for repairs.

58. Both sections arrived at Mussoorie early in May for recess quarters.

59. The health of both sections was on the whole very good, particularly that of the Makrán section.

60. A statement showing the details respectively of the outturns of the Makrán and Upper Burma sections will be found in the Appendix.*

* Captain Burn expresses himself perfectly satisfied with the work of all his assistants.

TOPOGRAPHICAL SURVEYS.

SOUTHERN MARATHA COUNTRY.

No. 10 Party.

Personnel.

Lieutenant A. J. Pilcher, R. E., Assistant Superintendent, 1st grade, in charge up to 25th April 1896, and from 15th June up to 5th July 1896.
Mr. A. J. Gibson, Extra Assistant Superintendent, 1st grade, in charge from 26th April to 14th June and from 6th July 1896.
" R. R. Dickinson, Extra Assistant Superintendent, 6th grade.
" J. A. Freeman, Sub-Assistant Superintendent, 2nd grade.
25 surveyors, sub-surveyors and others.

61. This party was under the charge of Lieutenant Pilcher, R. E., up to the 25th April 1896, and from the 15th June up to the 5th July 1896. During the remainder of the year the charge was held by Mr. Gibson.

62. The party took the field during the latter part of November 1895, and returned to recess quarters at Poona on the 1st May 1896.

63. The season's operations comprised the completion of the topographical survey on the 2-inch scale of the Southern Maratha country and the Konkan, in which only sheets Nos. 328, 350 and 351, and the eastern half of sheet No. 349, remained to be completed. The triangulation, traversing and detail survey on the 8-inch scale of Hubli city and environs was also carried out.

The above programme was completed, and there being no more work for the party in the Bombay Presidency, it has been transferred to Burma to carry on topographical surveys there.

64. The total outturn of the season's work is as follows :—

Triangulation	17·8 square miles.
Traversing	46·1 linear "
Topography, 2-inch scale	1,757·5 square miles.
Ditto, 8-inch "	17·8 " "

65. For the purpose of checking the 2-inch detail survey, 309 linear miles of check lines were run, in addition to *in situ* examination by Messrs. Gibson and Freeman. The survey of Hubli city was checked by 24 linear miles of plane-table traverse and by *in situ* examinations by Lieutenant Pilcher and Mr. Dickinson, who carefully tested the accuracy of the contouring.

66. Clinometric heights were observed by the detail surveyors in order to ensure a certain amount of uniformity in the contouring, and a certain number were checked by the assistants when running check lines.

67. The country surveyed is of the usual Deccan type, *i.e.* undulating and for the most part bare of trees, excepting in the neighbourhood of villages and on the banks of streams. There is a large amount of cultivation; in fact it would appear that every patch of cultivable ground is utilised.

68. The health of the party was good, with the exception of a few cases of fever and guinea-worm.

69. During the recess the fair-drawing of sheets Nos. 328, 349, 350 and 351 was completed, and also the map of Hubli city and environs. Twenty-four triangulation charts which were in an incomplete condition were finished. The Cujarat General Report, which has been under compilation for several years, was also brought to completion.

70. The total area surveyed on the 2-inch scale in the Southern Maratha country, since the commencement of operations in 1885-86, amounts to 21,082 square miles. The total cost of the survey has been R4,75,675, which gives a cost-rate per square mile of R22·5.

71. As stated above, the party has been transferred to Burma, and will be engaged next season on the topographical survey of the Shan States on the 1-inch scale, in conjunction with Nos. 11 and 21 Parties.

72. The recess office of the party was inspected by the Surveyor-General at Poona in September 1896 and everything was found to be in a satisfactory state. Orders were issued as o the disposal of the records and the furniture belonging to the party on its tansfer to Bangalore, its future recess quarters, and it was decided that Mr. Gibson should remain at Poona superintending the completion of the records and their transfer to Head-Quarters and the despatch

BOMBAY SURVEY.

INDEX TO THE TOPOGRAPHICAL SURVEY IN SOUTHERN MARATHA COUNTRY.

1895-96. No. 10 PARTY

NOTES.

The numerals 279, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

The figures and lines in strokes represent the numbers and limits of the Engraved sheets of the Indian Atlas.

REFERENCES.

Sheets published on Scale 1" = 1 Mile .... (272)

Surveyed during previous Seasons on Scale 2" = 1 Mile

.... Do ..... 1895-96 .... do .... do.

Triangulated during previous Seasons ....

Province or State Boundary ....

District .... do ....

Scale of Miles.



Photo. S. I. O., Calcutta.

No. 313-S. 97.

UPPER BURMA SURVEY.

INDEX TO THE TOPOGRAPHICAL SURVEY IN UPPER BURMA & SHAN STATES.

1895-96. **Nos. 11 & 21 PARTIES.**

NOTE.

The numerals **312**, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile

REFERENCES.

Area previously Surveyed

" Surveyed in Season 1895-96

" Triangulated in advance

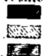


Photo. & I. O., Calcutta.

No. 350-S. 97.

of the office furniture to Bangalore, until December, when he would be superannuated.*

UPPER BURMA.

No. 11 Party.

72. This party remained in the charge of Captain Renny-Tailyour throughout the year, and continued the topographical survey of Upper Burma on the 1-inch scale, which had been commenced in the previous season.

Personnel.

Captain T. F. B. Renny-Tailyour, R.E., Deputy Superintendent, 1st grade, in charge.
Lieutenant W. M. Coldstream, R.E., Assistant Superintendent, 1st grade.
Mr. P. J. W. Doran, Extra Assistant Superintendent, 5th grade.
Mr. W. M. Kelly, Extra Assistant Superintendent, 6th grade.
Mr. H. G. Shaw, Sub-Assistant Superintendent, 2nd grade.

Surveyors and Sub-Surveyors.

Mahmud Hosein, J. Sebastian, Ramsabad, Abdul Rahim, Kudratullah, Mowni Ram, Nuruddin, Ram Pershad, Ali Husain, and six apprentices.

73. The season's programme comprised the survey of the country falling in sheets Nos. 360 and 361, and the completion of sheet No. 315, which was partially surveyed by No. 21 Party during the previous season. In addition to this work, a surveyor was detached to survey boundaries on the 1-inch scale in Karenni.

74. The party left recess quarters at Bangalore about the beginning of November 1895 and proceeded to Fort Stedman. Field operations were commenced during the first week in December.

75. There being an insufficient number of points for the surveyors in the country under survey, triangulation had to be pushed on at once and the computations worked out in the field. This work was for the most part entrusted to Mr. Doran, and on its completion he was employed in examining the work of the detail surveyors. Triangulation in advance for the ensuing season's work was carried out by Lieutenant Coldstream and Mr. Shaw in sheets Nos. 316, 362 and 407. Captain Renny-Tailyour also carried a small secondary series through sheets Nos. 407 and 408 and afterwards visited and inspected the surveyors.

76. The outturn of work for the season is as follows :—

	Square miles.
Triangulation	1,830
Topography, 1-inch scale	1,355

That the outturn was not larger is partly due to the difficult nature of the country, but is principally owing to the party being under-manned. A large addition to the establishment will be made before next season commences, both as regards European assistants and native surveyors, including four apprentices from Dehra Dun.

77. The country operated in is hilly and mostly covered with fairly open tree jungle. The highest range is Loi Maw, to the east of sheet No. 360, which rises to an elevation of over 8,000 feet. It is covered with dense tree jungle.

78. The health of the party was very good, and no serious delay to work was caused by sickness. There was not a single death in the party. There was considerably less fever than usual, owing to the partial failure of the rains in 1895 and their late commencement in 1896.

79. The establishment returned to Fort Stedman about the 1st May 1896 and proceeded to recess quarters at Bangalore, where the office was opened on the 1st June. During the recess the computation of all the triangulation was satisfactorily completed. The mapping of sheet No. 359 was completed in all respects, and that of sheets Nos. 315, 360 and 361 was completed with the exception of the hill drawing which it is intended to finish during the next field season. The survey of the boundaries in Karenni has also been fair drawn.

80. The programme for next season comprises the plane-tabling of sheets Nos. 316, 406 and 407. Gaps in sheets Nos. 316 and 407 and the whole of sheet No. 406 have to be triangulated for the season's detail survey. Sheets Nos. 403, 404 and 405 will be triangulated in advance, and the work carried as far as possible into the sheets to the east of these.

* Mr. Gibson, who was in charge of the party at the close of the year under report, speaks highly of the services rendered by Messrs. Dickinson and Freeman.
The members of the native establishment are also well reported on.

Besides the above work, Lieutenant Coldstream and three experienced surveyors will accompany Police columns in the Chin Hills west of Pakokku, and surveyor Mahmud Hosein will again survey boundaries in Karenni.

81. The recess office of the party was inspected by the Surveyor-General at Bangalore in September, who has made the following remarks:— "The work "of this party is good as far as it goes, but it is far too small in quantity; this is "not due to any fault on the part of the members of the party, but to the want "of men. This defect will be remedied gradually as men can be trained; in "this respect the new survey school at Dehra will be of assistance."*

SIND.

No. 12 Party.

82. This party, which had for some time been employed on cadastral surveys in Upper Burma, was transferred this season to the Bombay Presidency to commence a topographical survey of Sind, and with it was amalgamated the detachment which had been employed for the previous three seasons on the survey of the Indus river and which had completed its work last season.

Personnel.

Captain G. B. Hodgson, Officiating Superintendent, 2nd grade, in charge.
Mr. A. G. Wyatt, Extra Assistant Superintendent, 2nd grade.
" G. G. Vanderbeek, Extra Assistant Superintendent, 5th grade.
" R. F. Warwick, Sub-Assistant Superintendent, 1st grade.
" J. Smith, Sub-Assistant Superintendent, 1st grade.
" F. P. Walsh, Sub-Assistant Superintendent, 1st grade.
27 sub-surveyors.
9 draftsmen and computers.

83. The strength of the party is given in the margin. Captain G. B. Hodgson has held charge throughout the season, with the exception of 2 months when he proceeded on privilege leave and the charge devolved on Mr. Wyatt. Mr. B. G. Gilbert-Cooper, who held charge of the party previous to its transfer to Sind, was transferred to No. 7 Party (Upper Burma). All the Assistants formerly attached to the party were also transferred elsewhere and five new Assistants were appointed to it.

84. The first survey of Sind was carried out in 1856 and succeeding years on various scales according to the nature of the ground. The cultivated portions were surveyed *mauzawar* on the scale of 4 inches to the mile,—that is, the boundaries of the villages, or *dehs* as they are termed locally, were separately defined and laid down with all the interior details of water, cultivation, etc., surveyed in village circuits. The desert tracts were surveyed topographically only, on the 1-inch scale, while the 2-inch scale was employed for the uncultivated but cultivable portions.

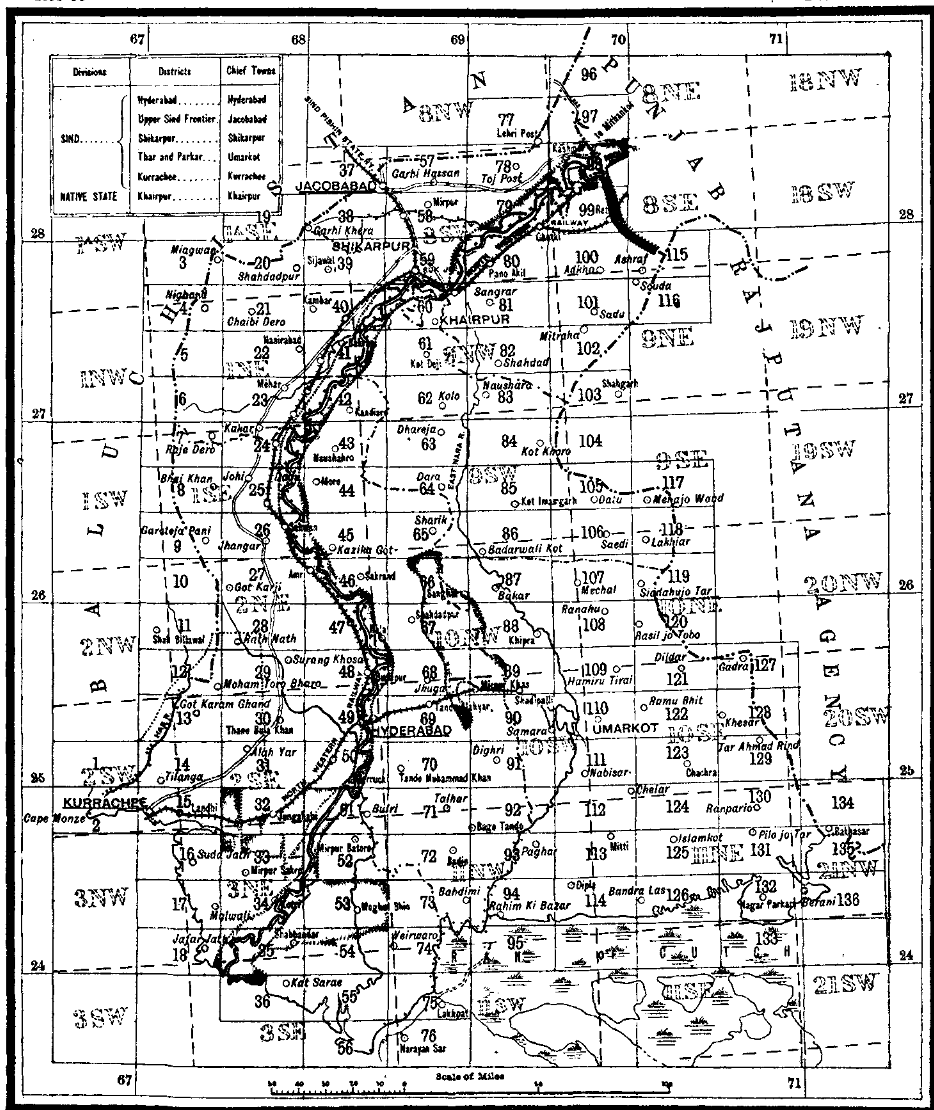
85. The re-survey of Sind was asked for by the Commissioner, the Honorable Mr. H. E. M. James, C.S., in 1892, as he stated that the maps of the old survey were defective and completely out of date owing to the "vast improvements which have been effected during nearly 40 years of British rule." No party was available, however, to take up the work till the past season, when No. 12 Party was released from Upper Burma. The Government of India having assented to its transfer to Sind, the Surveyor-General proceeded to Karachi, and in consultation with the Commissioner and other local officers it was proposed that the cultivated portions of the province which in the previous operations had been surveyed on the 4-inch and 2-inch scales should now be surveyed topographically on the 2-inch scale, but reduced by photography to one half for publication, whilst the hilly country to the west along the Baluchistan boundary should be surveyed on the 1-inch scale, and the desert portions adjoining Rajputana on the ½-inch, on which scale the whole of the rest of the desert has been surveyed. Village boundaries were to be rigorously traversed and if necessary properly marked. These proposals were submitted to the Government of India with the Surveyor-General's letter No. 2858, dated 15th

* Captain Renny-Tailyour reports well of the work done by his European assistants, Messrs. Doran, Kelly, and Shaw.
With the exception of one man, who was dismissed for bad work and dishonesty, the members of the native establishment are also well reported on.

1895-96

SIND SURVEY.

No. 12 PARTY.



Reg. No. 422, S. I. D.—Jan. 97—560.

Photo. S. I. O., Calcutta

No. 314-S. 97.

REFERENCES.

Surveyed in previous Seasons Scale 1″ = 1 Mile

....Do....in 1895-96...............do

....Do......do...........Scale 2″ = 1 Mile

Triangulated and Traversed in advance

Triangulated in advance by No. 15 Party, 1895-96

NOTES.

The numerals 63, &c., indicate the Standard sheets on the Scale 1 Inch = 1 Mile.

The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas

October 1895, to the Secretary, Revenue and Agricultural Department, and the survey on these lines was sanctioned in his letter No. $\frac{3121}{46-5}$, dated 28th idem.

It was also proposed that the 2-inch work was to be carried out first, commencing from the south, completing the survey of the Indus delta and proceeding steadily northward. Arrangements therefore were made and work commenced accordingly, but in January 1896 the local Government asked that the detail survey of the lands to be watered by the newly-constructed Jamrao canal in the Hyderabad and Thar and Parkar districts might be carried out next season, so the traverse survey in the south was stopped and that of the area in question taken up instead.

86. The field hands assembled at Karachi, whence the majority started for the field about the middle of November 1895, to take up the detail survey on the 1-inch scale of sheets Nos. 1 and 2 and on the 2-inch scale of sheets Nos. 16, 17 and 18, which are crossed by the Indus Delta Coast Series of triangulation executed during the previous season by the Trigonometrical Branch, and where no fresh triangulation was necessary. In sheets Nos. 1 and 2 and the western half of No. 15 also, sufficient fixed points were forthcoming from the Great Trigonometrical Survey to enable the detail survey to be carried out without further triangulation.

87. Secondary triangulation was extended over the eastern half of sheets Nos. 15, 16 and 17 starting from the Karachi Longitudinal Series and closing on the Delta Coast Series. A chain of triangulation was also commenced starting from the Sehwan Secondary Series, which runs just north of the 26th parallel and connects the Great Indus and Eastern Sind Meridional Series, which was to have run southwards approximately along the 69th meridian and closed on the Karachi Longitudinal Series. The country through which this chain has to pass is flat and, so far as the triangulation proceeded, pretty thickly covered with trees through which rays had to be cut; consequently but little progress was made. The chain will be completed next season.

In sheets Nos. 33, 34, 35, 53 and part of 54 no triangulation was done and the country was prepared for detail survey by lines of theodolite traverses starting from and closing on triangulated points by means of which the positions of the village tri-junctions have been fixed. The village boundaries were not traversed. Similarly the portion of sheet No. 32, south of the railway line, has been traversed, but no triangulation has been done. Sheets Nos. 35 and 53 were traversed only up to the limits of the great salt waste which occupies the extreme south-eastern corner of the Karachi district and which will not be surveyed until the cultivated portions of the province are completed.

88. The area traversed in Karachi district amounts to 1,794 square miles, of which 507 square miles only have been surveyed in detail during the season under report, leaving 1,287 square miles traversed in advance. The village boundaries in this area have not been traversed, as the question of traversing the boundaries was under discussion at the commencement of the season. The theodolite was set up at 2,600 stations and the total number of linear miles of chaining is 796·9. The mean angular error is 3·2 seconds per station and the average error per 1,000 links in the chaining is 1·71 links.

In the Hyderabad district an area of 1,071 square miles was traversed, including 163 villages, and here a regular village boundary traverse has been carried out, the boundaries themselves being surveyed by offset at the same time. The area thus traversed lies in sheets Nos. 66, 67, 68, 69, 87, 88 and 89.

Three main circuits were measured along the boundaries of the Shahdadpur *taluka* in Hyderabad and the Mirpur Khas and Sanghar *talukas* in Thar and Parkar, omitting the desert portion of the last-named *taluka*.

In no main circuit were the whole of the villages traversed. They will be completed next season.

89. The linear measurements were checked by connection with 2 G. T. stations, Pur h. s., of the Sehwan Secondary Series which lies on the northern limit of the area traversed, and Jan Mohomed T. S. of the Karachi Longitudinal Series, situated about 30 miles to the south. The closing error in northing and southing is 5·00 chains and easting and westing 0·19 chains in a total length of 146·44 linear miles of chaining.

90. The angular work in Hyderabad and Thar and Parkar was checked by observations for azimuth at 70 stations on the main and sub-circuits, giving an average of an azimuth for every 47 stations, or 11 linear miles.

91. No permanent marks have been put down anywhere at traverse stations, but as both field and village boundaries have been permanently marked by the Sind Revenue Survey (generally by rough stones partially embedded), these marks have been utilized as much as possible as traverse stations, so that practically a very large number of stations are permanently marked, in addition to which in the Hyderabad and Thar and Parkar districts the boundaries themselves have been surveyed with the theodolite.

92. The cost of the traversing without offsets to the boundaries is R9·4 per square mile and that of the boundary survey R16·9, the average size of the villages in the latter operation being 7·6 square miles.

93. Detail survey was confined entirely to the portion of the Karachi district to the west of the Indus and south of latitude 25° N. The area surveyed on the 1-inch scale is 677 square miles and comprises the entire sheets Nos. 1, 2 and 15.

The area of 2-inch survey completed is 1,241 square miles, covering the whole of sheets Nos. 16, 17 and 18 and portions of Nos. 33, 34 and 35. Large portions of sheets Nos. 24 and 35 were surveyed during the previous season by the Indus detachment, and the latter contains a large area of salt waste, the survey of which will not be taken up until that of the cultivated portions of the province are completed. Every effort was made to complete the survey of sheet No. 33, but before this could be done the heat became so intense that field work was no longer possible, and if it had been continued the quality of the work would have suffered.

94. The 2-inch work was tested by 44·2 linear miles of test lines and 739 *in situ* fixings and the 1-inch work from 148 *in situ* fixings. This gives an average of 1 fixing to each 1·7 square miles, besides the test lines, in the former, and in the latter 1 fixing to every 4·6 square miles. The work generally was excellent. Two half sections had to be rejected and were re-surveyed.

95. The cost-rate of the 1-inch detail survey is R10·4 and that of the 2-inch R24·9 per square mile. The latter rate is probably considerably higher than may be expected in future seasons owing to the intricate and difficult nature of the large area of coast land surveyed and the heavy expenditure involved in maintaining a fleet of boats.

96. The station and city of Karachi fall into sheets Nos. 2 and 15 and have been surveyed on the 1-inch scale, so as to allow of the completion and publication of the sheets, but it is proposed that the old 16-inch map of Karachi and environs of 1871 shall be brought up to date with the aid of the maps compiled in 1875 on the scale of 80 feet to the inch by the Sind Revenue Survey under Colonel Laughton. These maps have been kept up to date by the Municipality and they have consented to lend them for the purpose.

97. During the season a special traverse survey was carried out at the request of the Irrigation Department to fix the positions of certain marks that had been erected with a view to watching and recording the yearly changes that occur in the lower reaches of the Indus. It emanated from and closed on stations of main circuit No. 22 of the Indus River Survey, season 1894-95. The length of the traverse is 48·3 linear miles and the number of stations 79, of which 40 have been permanently marked by the Irrigation Department.

98. The field season closed about the middle of May 1896. It was unduly prolonged in order to complete as many standard sheets as possible. Notwithstanding the late date on which field work closed, there was very little sickness among the members of the party throughout the year, with the exception of one sub-surveyor who was on the sick list nearly the whole field season.

99. During the recess, the fair mapping was completed of the whole area surveyed, with the exception of sheet No. 33 which was only partially surveyed. Sheets Nos. 1 and 2 have been mapped on one sheet and were drawn on the 1-inch scale for reproduction, as was also sheet No. 15. The other sheets completed were Nos. 16, 17, and 18 which were drawn on the 2-inch scale for reduction by photography. Sheets No. 34 and 35, as mentioned before, were not completed in survey, but large portions of these two sheets were mapped by the Indus Detachment the previous season, and as they are not likely to be completed for some seasons now that the *locale* of operations has shifted, they have been drawn as far as surveyed and will be despatched to head-quarters for publication as a preliminary edition. They have been drawn on

the 2-inch scale for reduction, whereas the Indus Detachment worked on the 1-inch scale. The two surveys will therefore be amalgamated in the head-quarters offices.

100. The sheets cannot be despatched to Calcutta at once as the typing is in abeyance at present. The field sheets are studded with hamlets, called *gotes*, the names of which are temporary,—that is to say, they bear the name of the headman for the time being. During the Surveyor-General's recent inspection it was arranged, in consultation with the Commissioner, that lists of these *gotes* were to be sent to the Commissioner who would intimate which names should be entered and which omitted on the fair maps, or whether those with temporary names should be shown in different type. Lists have accordingly been submitted to the Commissioner, and as soon as the necessary instructions are received the maps will be completed and despatched to head-quarters, all arrangements having been made for completing them on the field.

The computations of the whole area triangulated have been completed and also of all the traversing in the Hyderabad and Thar and Parkar districts. In the Karachi district the computations have not been taken in hand of 740 square miles in sheets Nos. 53 and 54 and the portions of sheets Nos. 34 and 35 to the east of the Indus owing to the transfer of the seat of operations to the Hyderabad district.

101. During the recess season the survey of the Syari quarter of the Karachi city was commenced on the scale of 80 feet to the inch. The survey was asked for by the Municipality who have deposited a sum of R1,690 for it. The whole area to be surveyed is about 870 acres, of which 548 acres have been surveyed and tested by 5·98 linear miles of test lines by Captain Hodgson and Mr. Smith. In connection with the survey a record has been prepared of the occupiers of holdings.

The survey will be completed before the party takes the field again, and the fair maps will be drawn during the field season and will be despatched to head-quarters for photo-zincography as soon as completed.

102. Final orders regarding the programme for next season have not yet been received. A cadastral survey on the 8-inch scale of the lands watered by the Desert canal, partly in the Upper Sind frontier district and partly in Baluchistan territory, was asked for in October 1896 by the Irrigation Department who undertake to provide the funds for the present season. The area is said to be 600 square miles, and if the survey is sanctioned by the Government of India an endeavour will be made to carry out both the traversing and detail survey this season. Detail survey will also be carried on in sheet No. 33 which will be completed on the 2-inch scale and about 70 square miles of cultivated land in the south east of sheet No. 32 will be surveyed on the same scale.

The remainder of sheet No. 32 will be surveyed on the 1-inch scale by No. 15 Party.

The traversing of village boundaries and detail survey of sheets Nos. 66 and 87 will be completed omitting the desert portions, and the traverse survey of sheets Nos. 67, 68, 88 and 89.

103. The survey is much indebted to the ready assistance given at all times by the Collectors of Karachi and Hyderabad, Messrs. R. Giles and Woodburn, and the Acting Deputy Commissioner of Thar and Parkar, Mr. Mules; also by the *mukhtiarkars* of the various *talukas* in which operations were carried on. Babu Jote Sing Chander Sing Shahania, zamindar of Mirpur Sakro, especially distinguished himself in helping many members of the party to procure provisions and carriage throughout the season. His services to the survey have been brought to the notice of the Collector of Karachi.

104. The Surveyor-General inspected the recess office of the party at Karachi in September 1896.*

* Captain Hodgson reports that Mr. Warwick is the only one of his Assistants that he can commend as having done really good honest work. Of the native establishment the following are particularly deserving of mention :—Computers Elahi Bux, Narsu Dinkar and Laxuman Daji, Sub-Surveyors Faiz Bux, Irfan Ali, Mouladad Khan, Moula Bux, Gurmukh Sing, Muhammad Akbar, Ishar Sing, Muhammad Azam, Ali Muhammad Khan, Ramkinker Pershad, Fida Husen, Lall Behari Lall and Mahmud Ali.

BALUCHISTAN.

No. 15 PARTY.

105. This party remained in charge of Mr. Claudius throughout the year. It was divided into five detachments.

Personnel.

Mr. T. E. M. Claudius, Extra Assistant Superintendent, 4th grade, in charge.
" E. A. Wainwright, Extra Assistant Superintendent, 4th grade.
" G. A. Knight, Extra Assistant Superintendent, 6th grade.
" G. P. Tate, Extra Assistant Superintendent, 6th grade.
Yusaf Sharif, Khan Bahadur, Sub-Assistant Superintendent, 1st grade.
Hira Singh, Rai Bahadur, Sub-Assistant Superintendent, 1st grade.
Imam Sharif, Khan Bahadur, Sub-Assistant Superintendent, 2nd grade.

Surveyors and Sub-Surveyors.

Ahmed Ali, Khan Bahadur, Abdul Guffar, Khan Sahib, Hussain Baksh, Sheikh Mohiuddin, Khan Bahadur, Asgar Ali Beg, Jaffer Ali, Gopal Singh, and 19 others.

106. The head-quarters of the party was located at Shujabad during the field season. Mr. Claudius with his detachment arrived there about the 1st December 1895, and immediately proceeded with the 2-inch survey required by the Military Department to the south of Multan. All the required area, 702 square miles in extent, was completed and checked early in March, after which the head-quarters returned to Quetta, and traversing in connection with the settlement survey of the Pishin district was resumed.

107. Mr. Knight, who had just been transferred from No. 11 Party, was directed to undertake the triangulation for 1-inch topography on the Sind frontier, north of Karachi. This he accomplished in a sound methodical manner, very closely triangulating about 2,000 square miles in advance, and returned to Quetta by the end of April 1896.

The Baluch-Afghan Boundary Commission detachment, under Mr. Tate, completed 12,000 square miles of triangulation, 800 square miles of topography on the ½-inch scale and 11,200 square miles on the ¼-inch scale. This was actually a revision of old reconnaissances. An extract from Mr. Tate's narrative report on the operations of his detachment will be found in the Appendix.

108. Rai Bahadur Hira Singh, on his return from privilege leave in April 1896, was instructed to revise and strengthen the triangulation in Zhob, executed by Captain Mackenzie during the previous year. Observations were taken at 14 hill stations covering an area of about 2,500 square miles. The computed results are exceedingly good. This work, in connection with Mr. Wainwright's, has made the triangulation in Zhob much more reliable.

109. Sub-surveyor Jamaluddin was deputed to go to Persia and report himself to Captain Sykes, the British Consul at Kirman, who had applied for his services. The sub-surveyor mapped about 14,000 square miles on the ⅛-inch scale. When the British Consul reached Kuhak, Jamaluddin's services were placed at the disposal of Colonel Wahab, in charge of the survey detachment with the Perso-Baluch Boundary Commission. Surveyors Ahmed Ali, Khan Bahadur, and Hussain Baksh were also detached for duty with the Commission.

110. The total outturn of the party is as follows:—

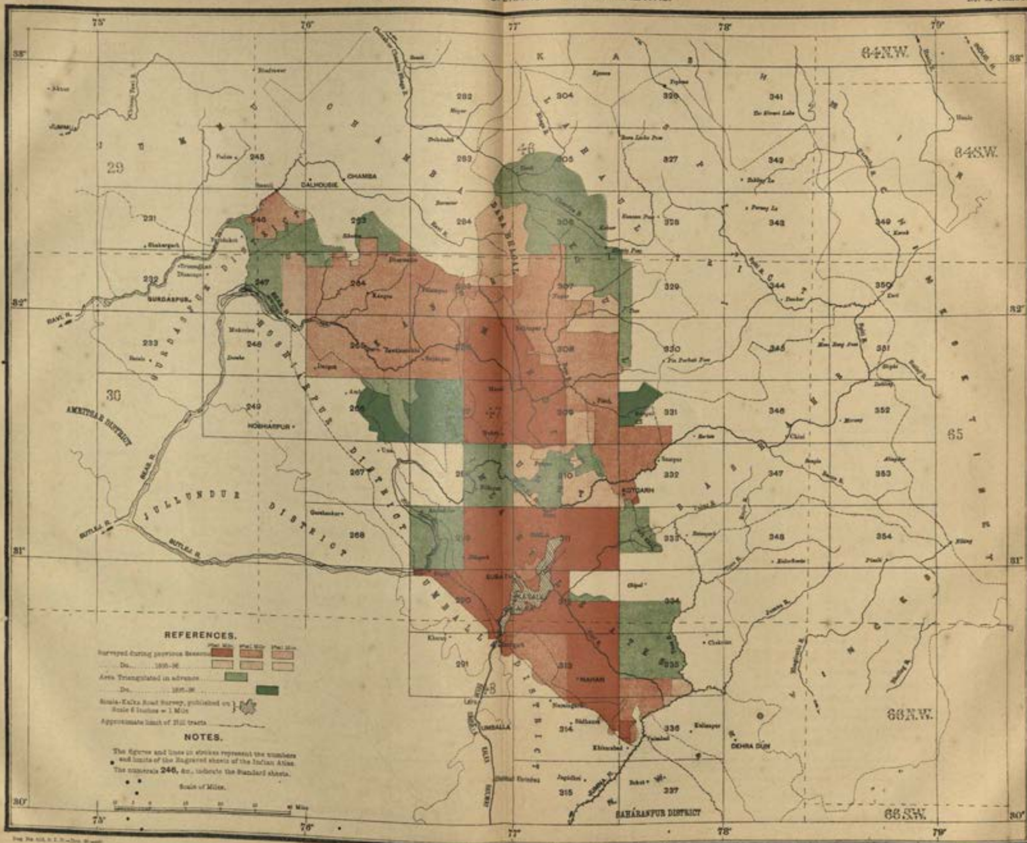
	Square miles.
Triangulation for 1-inch survey	2,000
Ditto ½-inch do.	5,200
Ditto ¼-inch reconnaissance	12,000
TOTAL	19,200

	Linear miles.
Traversing for 16-inch survey	100
Ditto 2-inch do.	222
TOTAL	322

	Square miles.
Topographical survey, 2-inch scale	702
Ditto ditto, ½-inch do.	11,307
Geographical ditto, ¼-inch do.	11,200
Ditto ditto, ⅛-inch do.	14,000
TOTAL	37,209

PUNJAB SURVEY.

1895-96. INDEX TO THE SURVEY OPERATIONS IN THE HIMALAYAS. No. 18 PART I.



111. During the recess, all the computations in connection with the season's triangulation were completed. All the latitudes and longitudes of the Persia triangulation have been revised and reduced to G. T. terms. The year has been a record one so far as drawing is concerned. Over 14,000 square miles of very intricate country have been mapped on the $\frac{1}{2}$-inch scale; over 9,000 square miles on the $\frac{1}{4}$-inch scale; and over 16,000 square miles have been reduced from the $\frac{1}{2}$-inch scale to the 16-mile scale and forwarded to the Simla Drawing Office.

112. The programme for next season will comprise the following operations :—

Triangulation for the 1-inch survey on the Sind frontier and for 12-inch topography in Kach Kotal. Traverse survey for the 2-inch survey round Multan. Topography on the 1-inch scale on the Sind frontier; on the 2-inch scale of the country north of Multan; and on the 12-inch scale in Kach Kotal.

113. The recess office of the party was inspected by the Surveyor-General at Quetta in September 1896.*

HIMALAYAS, PUNJAB.

No. 18 Party.

114. At the commencement of the year under report Captain J. M. Fleming, S.C., relieved Lieutenant C. L. Robertson, R.E., of the charge of the party, which the former held till the return of Lieutenant Colonel R. A. Wahab, R.E., from deputation with the Pamir Boundary Commission; and the latter, having been shortly after deputed to the Perso-Baluch Boundary Commission, handed over the charge of the party to Mr. C. D. Potter on the 15th January 1896.

Personnel.

Lieutenant-Colonel R. A. Wahab, R. E., Officiating Superintendent, 2nd grade, in charge, from 24th December 1895 up to 14th January 1896.

Captain J. M. Fleming, S.C., Officiating Deputy Superintendent, 1st grade, in charge, up to 23rd December 1895.

Lieutenant F. W. Pirrie, S.C., Assistant Superintendent, 2nd grade.

Mr. C. D. Potter, Extra Assistant Superintendent, 4th grade, in charge from 15th January 1896.

Mr. W. Robert, Extra Assistant Superintendent, 5th grade.
„ W. A. Fielding, „ „ 6th „
„ R. Waller-Senior, Sub- „ 1st „
„ W. M. Gorman, „ „ 2nd „
„ E. J. Biggie, „ „ 3rd „

Surveyors and Sub-Surveyors.

Shah Nasiruddin, Atma Singh, Ram Saran, Asmatullah Khan, Dalbir Rai, Amir Singh, and 23 others.

115. The work of the party, as in former years, comprised the topography of British tracts on the 4-inch scale; of the Native States on the 2-inch scale; of all demarcated forests, wherever situated, on the 4-inch scale; and of unproductive regions, in high altitudes, generally above the limit of tree growth or under perpetual snow, on the 1-inch scale.

116. The localities that were under survey were :—

(i) The Kangra district, and Kullu subdivision of that district, on the 4-inch scale.
(ii) The Native States of Mandi and Suket, and small portions of the Simla Hill States, on the 2-inch scale.
(iii) Special surveys of the forests of the Patiala and Sirmur Native States, on the 4-inch scale.
(iv) High ground in Chota Bangahal (Kangra district), on the 1-inch scale.
(v) Triangulation in advance of topography in the Kangra district.
(vi) The classification of forest growth and soils *pari passu* with the topography in British tracts, and special forest surveys.

117. All the above operations were in continuation of the previous season's work. The classification of forest growth and soils is now being made in Kullu, Patiala, and in Kangra, and local officers are supplied with ferrotyped

* Mr. Claudius reports that all his assistants, both European and native, have worked with zeal, energy and cheerfulness. He particularly mentions Mr. Wainwright and Yusaf Sharif, Khan Bahadur, for their assistance during the recess.

Major Bythell desires that mention may be made of the good services rendered by Hira Singh, R.B., and Asghar Ali, of this party, during the Chitral Expedition in 1895—the former in triangulation and the latter in topography.

reproductions of the field work in advance of the publication of the 4-inch sheets which contain the full topographical details; the classification of the Sirmur forests is made according to a special system.

118. The party was divided into three detachments during the field season, as described in last year's Report, each under an Extra Assistant Superintendent, who exercised supervision over the three principal operations in the localities specified above.

The first detachment was employed on the Patiala and Sirmur special forest surveys in what are known as the Nahan Siwaliks; also in the lower Himalayas rising from the banks of the Jumna river, and in the hill tracts of Patiala in the vicinity of Simla. This detachment left about the end of October to carry on work in the less elevated localities during the winter, leaving the higher regions to be dealt with in the spring; it returned to Simla about the end of April. The country in the Siwaliks consisted of a mass of precipitous peaked hills, between which flowed a network of streams. The minuteness of the features concealed within the forests in this locality and also within the more densely forest-clad slopes of the bolder features of the lower Himalayas, up to about 4,000 feet, rendered the delineation of the topography in these parts extremely laborious.

The second detachment was employed in Kullu in the locality from the valley of the Parbati to the snowy ranges above it and from the valley of the Sutlej river to the hill ranges above it. This detachment left Simla during the month of August, so as to reach the high ground in Kullu immediately after the cessation of the monsoon, when alone work there is practicable; it moved to the valley of the Sutlej on the approach of the winter snows, where it worked till early in March. The ground surveyed from the Parbati valley, 4,300 feet above sea-level, to the snowy peaks 17,800 feet in elevation, consisted of a desolate tract, above the limit of forest growths, with mighty cliffs of solid gneiss more or less covered with snow. The streams traversing the ground had a fall of 2,350 feet per mile. The *thaches* (or sheepfolds) situated on natural terraces on this stupendous wall of rock, or in dismal glens in the forest-clad portions, were the only camping grounds for the surveyors where water and fuel were obtainable. One of five glaciers which form the source of the main stream is 13 miles long.

The third detachment was employed in the Nurpur tahsil of the Kangra district, in the low hills of the outer Himalayas. This detachment left Simla about the middle of October and returned about the middle of April. The ground consisted of low flat-topped hills covered with forest, and occasional patches of cultivation in the valleys, the streams through which flow between precipitous ravines that necessitate very circuitous journeys from place to place. The intricate features of this tract, combined with the low brushwood jungle outside the forest areas, added much to the labours of the surveyors.

119. Lieutenant F. W. Pirrie was attached to the party to complete his instruction during his period of probation; he left Simla on the 13th November and triangulated ground in the Kangra district. Mr. R. Waller-Senior was, owing to the favourable season following a mild winter, able to carry on the triangulation of the high ground above the Tirthan valley in Kullu during the spring months; he returned to Simla on 23rd June 1896.

120. The areas topographically surveyed are as follows :—

	Square miles.
Kangra, 4 inches=1 mile	135·0
Kullu, ditto	161·7
Sirmur, ditto	98·5
Patiala, ditto	18·5
Mandi and Suket and Simla Hill State, 2 inches=1 mile	316·0
Kangra, 1 inch = 1 mile	88·0
TOTAL	817·7

The total outturn is 126·5 square miles in excess of the average of the previous nine years, though 66·5 square miles in defect of the previous year, which was an exceptional year. This decrease is due chiefly to the arrangement mentioned in paragraph 113 of last year's Report, by which the usual length of the field season was curtailed and the recess season increased. This change has satisfactorily met the anticipated results by a very material increase of fair

mapping that was falling into arrears by reason of the very limited length (about 4 months) of previous recess seasons.

121. The surveys of the following forest blocks are included in the areas on the 4-inch scale shown above :—

LOCALITY.	Number of blocks.	Area in square miles.
Kangra	20	7·3
Kullu	54	122·0
Patiala	47	9·5
Sirmur	70	61·2
TOTAL .	191	200·0

122. The outturn of triangulation was 510 square miles, including 80 square miles over an area previously reported as triangulated, in which additional points were necessary for 4-inch surveys.

123. The cost-rates per square mile of the various operations are as follows :—

	R
Triangulation	19·8
Detail survey, 4-inch	89·6
Ditto, 2-inch	49·1
Ditto, 1-inch	12·8
Special forest surveys, 4-inch	81·5

The cost of triangulation is R5·5 in excess of the previous year; the rates for this class of work usually fluctuate according to the pay of the individuals employed on it. The cost-rates of the 4-inch and 2-inch surveys are R1·8 and R3·6 per square mile below the average for the past nine years, though R0·9 and R12·7, respectively, in excess of the previous year, which is due to higher and more difficult ground being surveyed on both scales, and also to the smaller outturns noticed in paragraph 120.

124. The instruction of native military students from the Thomason Civil Engineering College for a two years course in surveying continued to form one of the duties of this party. One of the two native soldiers under training completed his course during the recess and rejoined his regiment, the 9th Goorkhas, at Lansdowne; another man from the 6th Bengal Infantry took his place.

125. The party continued to render professional aid to the Deputy Commissioner of Simla and the President of the Simla Municipality during the recess months, the former in the settlement of boundary disputes, and the latter in revisionary surveys for the preparation of maps up to date.

126. The recess office of the party was inspected by the Surveyor-General in July 1896, and by the Superintendent, Trigonometrical Surveys, during the 19th August and following days. They both expressed approval of the arrangements in dealing with the several operations in progress, and also of the general efficiency of the party.

127. The programme for the season 1896-97 for this party will be the triangulation for the 2-inch topographical survey in the Simla Hill States and for the 4-inch survey in the Kangra district. The detail survey will consist of 2-inch topography in the Suket and Sirmur Native States and in the Simla Hill States, and of 4-inch topography in continuation of previous season's survey in the Kangra district in the valley of the Bias. The special forest survey of the Sirmur State on the 4-inch scale will also be continued.*

* Mr. Potter reports that Messrs. Robert and Fielding exercised much care in the supervision of their detachments, the latter showing good judgment in dealing with district officials; and also reports very satisfactorily on Messrs. Waller-Senior, Gorman and Biggie, who worked with zeal and energy; and that Surveyor Shah Nasir-ud-din, Sub-Surveyors Asmatullah Khan and Ram Saran, and Clerk Amir Singh deserve special mention.

UPPER BURMA.

No. 21 Party.

128. Mr. Wilson was in charge of this party at the commencement of the year under report, but was relieved by Lieutenant Robertson on the 1st December 1895, who remained in charge until the 16th April 1896, when Major Longe returned from special duty at the India Office and re-assumed the charge.

Personnel.

Major F. B. Longe, R.E., Superintendent, 2nd grade, in charge from 16th April 1896.
Lieutenant C. L. Robertson, R.E., Assistant Superintendent, 1st grade, in charge from 2nd December 1895 up to 15th April 1896.
Mr. A. J. Wilson, Extra Assistant Superintendent, 1st grade, in charge up to December 1st, 1895.
„ A. J. James, Extra Assistant Superintendent, 4th grade.
„ W. F. E. Adams, Sub-Assistant Superintendent, 2nd grade.

Surveyors and Sub-Surveyors.

Ikbaluddin, Lachman Jadow, Mohamed Latif, Ganu Mal, Natha Singh, Mohamed Naki, Budhi Balram, Jamna Pershad, and five apprentices.

129. The party left its recess quarters at Bangalore during the last week of October 1895 and re-assembled at Mandalay, where the various detachments were told off, supplied with instruments, etc., and then despatched to their respective fields of operations.

130. The operations of the season comprised :—

(1) The commencement of the 1-inch topographical survey of the Northern Shan States.
(2) Geographical surveys on the ¼-inch scale in the Myitkyina district in connection with certain military expeditions operating in those localities.
(3) Continuation of the demarcation of the Burma-Siam boundary.

131. The distribution of the party was as follows :—

Lieutenant Robertson, with Messrs. Wilson, James and Adams, and the head-quarters, were employed on the regular 1-inch survey in the Northern Shan States.

Lachman Jadow and Mahomed Naki accompanied the Sana columns in the Myitkyina district, and Mahomed Latif proceeded with another column to the east of the Myitkyina.

132. Thus it will be seen that, as usual, the party was scattered over a very large area, and most of the trained hands were on some special duty and not available for the regular topographical work.

133. On the 1-inch scale an area of 937 square miles was surveyed in detail in Hsipaw State and 3,188 square miles was triangulated. This latter extended over portions of Hsipaw State, Lawk Sawk in the Southern Shan States, and the Mandalay and Ruby Mines districts. The 1-inch work was tested by Major Longe, Lieutenant Robertson and Mr. Wilson, and found very fair, though the hill-shading was not very good.

134. The country traversed by the Sana columns was of very limited extent, and consequently the outturn of the surveyors with it was very small, amounting to only 1,340 square miles on the ¼-inch scale.

135. Surveyor Ikbaluddin, who was employed on the Burma-Siam boundary in the Amherst district, satisfactorily carried out the duties allotted to him, and completed the survey of the boundary.

136. The country surveyed on the 1-inch scale is one-half mountainous and the rest flat or undulating. It is intricate and almost entirely covered with jungle or forest. The mountainous area is very sparsely populated, but the remainder is fairly so, and though the villages are mostly small, they are numerous.

The country surveyed on the ¼-inch scale is mountainous and intricate. The fine peak Sabu Pum, on the China boundary, stands about 13,000 feet above sea-level and some thousands above its neighbours.

137. The health of the party while in the field was good, but most of its members suffered from fever and other complaints on return to recess quarters.

138. The high cost-rates of both the triangulation and detail survey on the 1-inch scale, as compared with those for similar works in India, *viz.*, R10

per square mile for triangulation and R31·9 for detail survey, are due to the following causes:—

(1) A very small number of surveyors in proportion to the European establishment was available for detail survey. Arrangements are, however, being made to rectify this.
(2) Increased rates of pay and local allowances are granted to all members of the various parties in Burma below the rank of Superintendent, 2nd grade.
(3) Higher rates of travelling allowance are granted.
(4) *Khalásis* have to be imported from India.
(5) The cost of transport and of coolies generally is quite double that paid in India.
(6) Interpreters have to be employed with each squad, which alone raises the cost-rates one rupee per square mile.

Transport animals are, however, becoming yearly less expensive to hire, and railway communications are gradually becoming available, and the cost-rates should decrease gradually within limits; but the other extra expenses are necessary and cannot be reduced, at any rate for the present. The Burmans are, however, becoming yearly more sensible and amenable to discipline, and before long no doubt will take service as surveyors in local topographical parties; the work is peculiarly suited to them, as they are very intelligent, quick to learn and deft with their fingers, and though they would require more pay, this extra expense would to a great extent be compensated by their knowledge of the language and country, and in various other ways. The *khalásis*, however, will at any rate for a long time have to be recruited from India.

139. Field operations ceased on May 10th, 1896, and the party returned to recess quarters at Bangalore by the steamer of the 22nd May, and the recess office was opened on the 1st June.

140. During the recess the computations have been completed. On the 1-inch scale, sheet No. 306 has been drawn, and also the greater part of No. 307.

141. The programme for next season is as follows:—On the 1-inch scale, sheets Nos. 258, 259, 260 and 307 will be completed and sheets Nos. 304, 305, 306, 351, 352, and 353 will be taken up. Sheets Nos. 397, 398, 399 and 400 will be triangulated, besides the incomplete portions of Nos. 257, 258, 259, 350 and 351.

142. The recess office of the party was inspected by the Surveyor-General at Bangalore in September 1896. A little more experience is required in preparing the 1-inch fair maps; in other respects everything was found in good order. The same remarks regarding the strength of the establishment that were made on No. 11 Party are equally applicable to this party.*

FOREST SURVEYS.

CENTRAL PROVINCES.

No. 14 Party.

143. The charge of the party remained in the hands of Major W. J. Bythell, R.E., from the commencement of the survey year up to 10th May 1896, with the exception of a period of one month (from 2nd November to 3rd December 1895) when he was on privilege leave, and Mr. J. Keating, Extra

Personnel.

Major W. J. Bythell, R.E., Deputy Superintendent, 2nd grade, in charge up to 10th May 1896.
Mr. C. F. Erskine, Deputy Superintendent, 2nd grade, in charge from 11th May 1896.
" N. C. Gwynne, Extra Assistant Superintendent, 3rd grade.
" J. Keating, " " " 6th grade.
" B. R. Hughes, Sub-Assistant Superintendent, 1st grade, from 25th April 1896.
Munshi Rahmatullah, Sub-Assistant Superintendent, 2nd grade.
Mr. J. O. Greiff, " " " 2nd grade.
" M. C. Petters, " " " 3rd grade.

Surveyors and Sub-Surveyors.

Muhammad Zakaria, Gurdutt Singh, Karimdad Khan, Ram Singh, Mahadeo Daji and 48 others.

* Major Longe reports well of the manner in which his assistants performed their duties, both in the field and in recess. Of Mr. A. J. Wilson he writes—

"I look upon Mr. Wilson as a most valuable assistant, and the Department will suffer much loss by his compulsory retirement next year. He has always shown himself most painstaking and conscientious and sets a high example to those with whom he comes in contact."

Of the native establishment the following are specially mentioned:—Ikbaluddin, Lachman Jadow, Mohamed Latif, Ganu Mal, Natha Singh and Jamna Pershad.

Assistant Superintendent, 9th grade, temporarily officiated for him. Major Bythell was transferred to No. 17 Party from 11th May 1896, and Mr. C. F. Erskine was appointed to the charge of this party from the same date.

144. The party took the field as usual on 1st December 1895 and continued survey operations till the second week of May 1896. One section of the party remained in the field till 25th of May to complete some work urgently required by the Forest Department.

145. The field work of the party consisted of detail survey on the scale of 4 inches=one mile in districts Betul and Damoh, and triangulation and traversing of forest boundaries in advance of topography in districts Damoh and Bilaspur.

146. Detail survey was carried out in the forests remaining to be surveyed in district Betul in sheets Nos. 24, 25, 35, 36 and 37, and also in the forests included in the northern range of district Damoh and a small portion in the central range of the same district. The area surveyed is 432·9 square miles in district Betul and 217·7 square miles in district Damoh, making a total of 650·6 square miles. This area is greater than that surveyed during the past year. The chief reasons which brought about the increased area are—

(1) The ground in district Damoh, being quite flat, was easier to survey than that in which operations were carried out last year.

(2) An area of about 50 square miles of forest in district Betul, which was not included in the original programme of the party, was set apart for detail survey by the Forest Divisional Officer, Betul, late in the season. To finish this area one section of the party was left working in that district till the 25th of May 1896.

147. The survey of all Government forests in the Betul district, of which detailed maps were required by the Forest Department, has now been completed. All the work was rigorously tested while in progress by the Assistants of the party by *in situ* fixings and check lines of a total length of 384·2 linear miles. The Executive Officer also tested most of the plane-table sections by *in situ* fixings. The work was generally found to have been done with accuracy and care.

148. The triangulation was carried out in sheets Nos. 64, 65, 66, 84, 85 and 86 of district Damoh and sheets Nos. 179, 180 and 201 of district Bilaspur, covering an area of 593 and 572 square miles respectively in the two districts. This triangulation embraces an area, for actual topography, of about 350 square miles in district Damoh and of about 500 square miles in district Bilaspur.

149. The amount of traversing of forest boundaries done in the several districts is as follows:—

	Linear miles.
District Betul	65
„ Damoh	1,295
„ Bilaspur	137

About 200 linear miles of the above work in district Damoh and the whole of it in district Betul was carried out over the ground which came under detail survey operations during the field season, and the balance is in advance for the coming year.

150. The classification of forest growth and soil of all the area surveyed in detail during the season was executed by the plane-tablers during the progress of their work on separate skeleton traces. These traces were fair drawn during the recess season and will be supplied, in original, to the Forest Officers concerned.

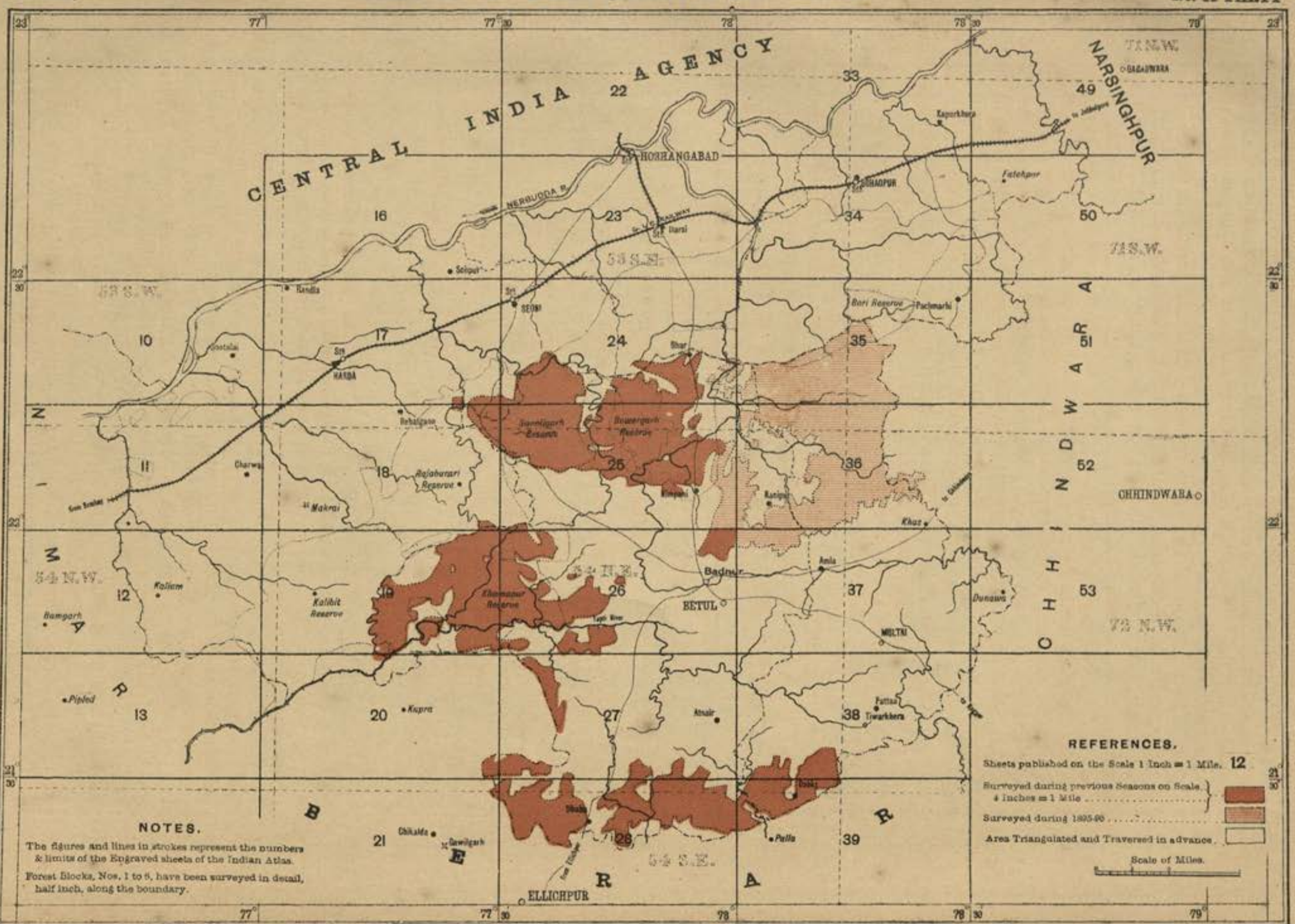
151. The country surveyed in detail in district Betul is generally very hilly and thickly clad with forest and bamboo. The northern portion of it is almost impassable for camels, as there are no roads over the ground, but merely foot-paths along hill-sides. The country is very sparsely populated, and the surveyors had considerable difficulties in obtaining coolie labour. Provisions had to be imported through paid *banias*, as little or nothing was to be had locally. The water-supply throughout this work was very limited, and what there was was found to be very unwholesome. Except on the banks of large streams the water generally dried up in the commencement of the summer season, thus throwing undue difficulties in the way of plane-tablers. In the southern portion of the work several villages were met with, but these were merely small hamlets inhabited by Gonds or Gowlis whose cattle graze in the forests. The ground

CENTRAL PROVINCES SURVEY.

1895-96.

INDEX TO THE FOREST SURVEY IN DIST. BETUL.

No. 14 PARTY



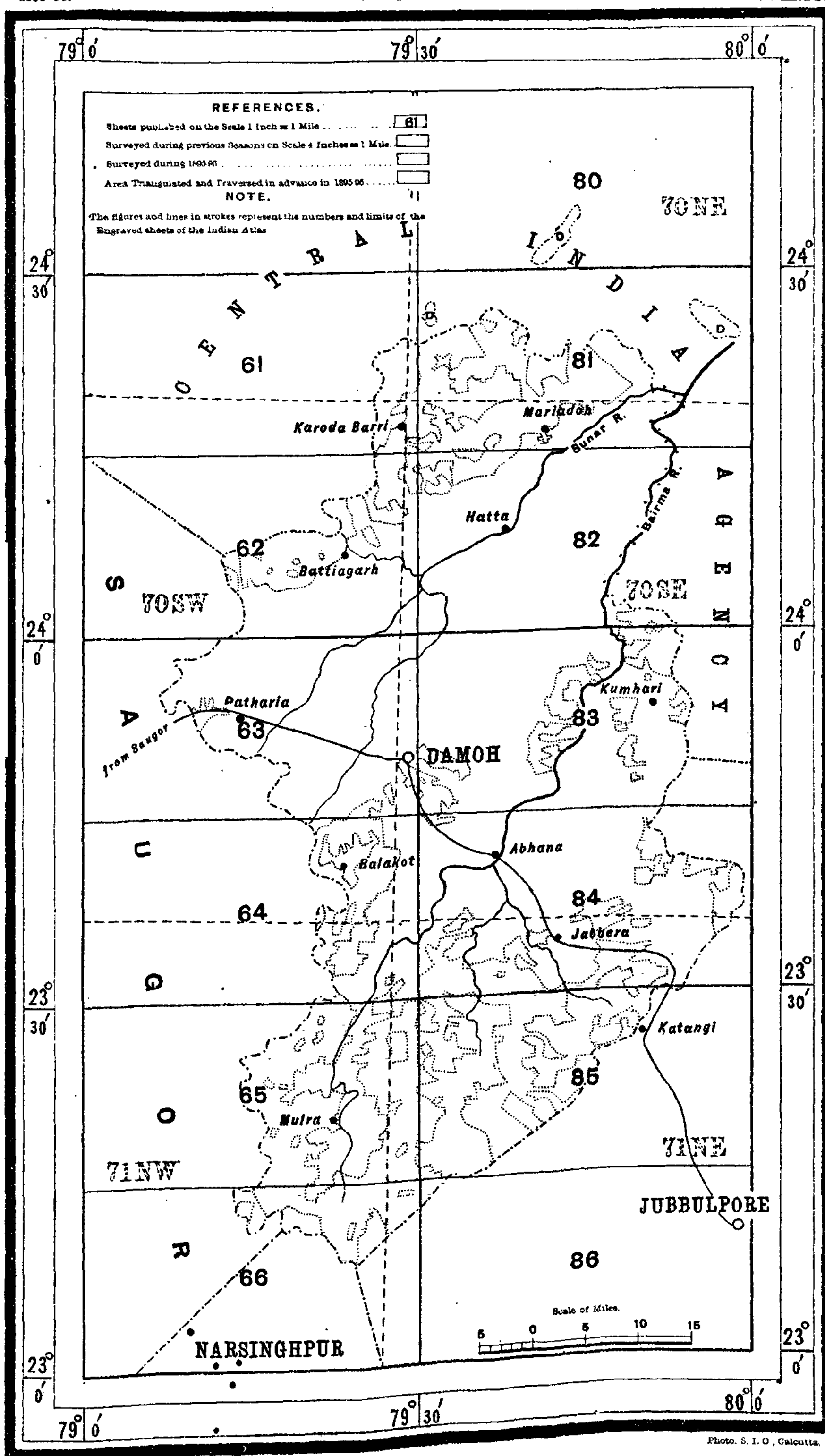
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Photo. S. I. O., Calcutta.

No. 461-S. 96.

CENTRAL PROVINCES SURVEY.

1895-96. INDEX TO THE FOREST SURVEY IN DIST. DAMOH. No. 14 PARTY.



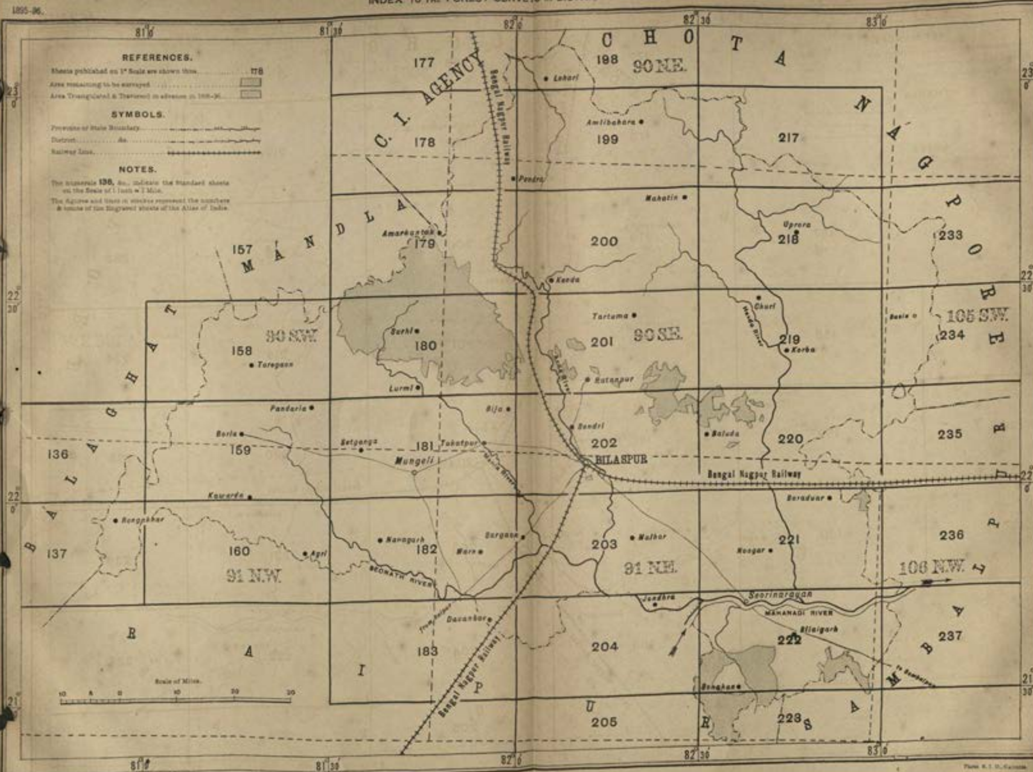
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CENTRAL PROVINCES SURVEY.

INDEX TO THE FOREST SURVEYS IN DISTRICT BILASPUR.

No. 14 PARTY.

1895-96.



No. 316-S. 97.

on the whole was very unhealthy throughout the season, and this, combined with the difficulties mentioned above, rendered the survey work tedious and slow.

Several large streams traverse this portion of the work; chief among them are the Tawa, the Sonbhadra and the Bharanga rivers. These retain water in them throughout the year, and are fordable everywhere within the limits of the work.

The country surveyed in district Damoh is generally flat, and the forest growth is mostly miscellaneous. In few places only teak and bamboo are found. Several *malguzari* villages, and some of them large ones, border the Government forest, the two largest being Mariado and Fatehpur. There is a Post Office and a Police station at each of these villages.

There are no large rivers of importance running through the work, but several cart tracks and foot-paths cross the ground. Provisions and coolie labour are obtainable locally with little trouble and previous arrangement.

152. The health of the party in the season under report, though slightly better than last year, was on the whole far from satisfactory. The squads working in district Betul suffered much from fever and dysentery, and the work of two sub-surveyors was brought to a standstill for over a month and three weeks respectively on account of the sickness of themselves and their *khalásis*. The establishment in district Damoh were greatly troubled with guinea-worm in addition to the ordinary complaints from fever and dysentery.

153. The fair mapping pertaining to the season's topography and comprising 50 standard sized sections of sheets Nos. 24, 25, 35, 36, 37, 61, 62, 63, 81, 82, 83 and 84 will be completed and sent to press before the party goes to field. The computations of triangulation and traversing done during the season have nearly been completed and there will be no arrears in either work by the end of this recess season.

154. In conformity with the new orders on the subject of the preparation of the General Report, issued with Departmental Order No. 3 (Professional), dated 26th March 1896, the data and charts of triangulation pertaining to the current year's field work in district Damoh have been compiled and prepared, and arrangements will be made to keep this work up to date as the survey operations progress. It is, however, very doubtful when this party will be able to clear off the arrears of General Reports of the work previously done in districts Hoshangabad, Nimar and Betul.

155. The data of co-ordinates of all the forest boundary pillars in district Hoshangabad, with skeleton plots of traverses showing every fifth station, have been prepared and supplied to the Forest Divisional Officer. The data for districts Betul and Nimar are well in hand, and those for district Damoh are up to date.

156. It was remarked in paragraph 180 of last year's Report that the cost-rates of this party for season 1894-95 were exceptionally low for reasons given therein, and that the cost-rates for this year would approach the figures for season 1893-94. The cost-rates for this year have indeed increased since last year; but it is satisfactory to note that they are still considerably below those for season 1893-94 under each class of work, as the following statement will show:—

Class of work.	Season		
	1895-96.	1894-95.	1893-94.
	R	R	R
Detail survey per square mile	81·2	67·4	89·0
Triangulation ditto	6·5	8·9	17·7
Traversing per linear mile	13·6	11·7	17·5

157. Three military students were attached to this party for survey training during the year. They had been with the party since December 1894, except for a period of eight months (April to November 1895) in which two of the men belonging to the Corps of Guides accompanied the Chitral Relief Force with their regiment. They were fully trained in plane-tabling on the 4-inch scale and were made to execute independent survey on this scale separately. They

were also given some lessons in the use of the theodolite and other survey instruments in ordinary use with a topographical party. They were sent back to rejoin their regiments at the end of the field season in May last.

158. The programme for the ensuing field season is as follows:—

(a) Triangulation in the Government forests in districts Bilaspur and Sambalpur, completing this work in the two districts.

(b) Theodolite traversing of all the forest boundaries over the ground to be triangulated.

(c) Detail survey of all the forests remaining to be surveyed in district Damoh.

(d) Classification of forest growth and soil of the area which will come under detail survey operations.

159. The office of the party was inspected by the Officiating Superintendent, Trigonometrical Surveys, at Mussoorie, on 4th August 1896, and he was thoroughly satisfied with the work of the party. The Surveyor-General of India also visited the party on 23rd July 1896.*

BOMBAY PRESIDENCY.

No. 17 PARTY.

160. The charge of this party remained in the hands of Lieutenant-Colonel J. R. Hobday, S.C., until the 25th January 1896, when he was compelled through sickness to proceed on furlough. The charge then temporarily devolved on Mr. C. E. Tapsell until the 20th May, when Major Bythell, R.E., was posted to the party and assumed charge.

Personnel.

Lieutenant-Colonel J. R. Hobday, S.C., Superintendent, 2nd grade, in charge up to 25th January 1896.
Major W. J. Bythell, R.E., Officiating Deputy Superintendent, 1st grade, in charge from 21st May 1896.
Mr. C. E. Tapsell, Extra Assistant Superintendent, 4th grade, in charge from 26th January up to 20th May 1896.
" S. F. Norman, Extra Assistant Superintendent, 6th grade.
" C. A. Norman, " " " " "

Surveyors and Sub-Surveyors.

Gopal Vishnu, G. R. Bhopatkar, R. V. Joshi, Govind Gopal, N. V. Bhopatkar, and 38 others.

161. The party continued the survey of forest areas in the three circles of the Bombay Presidency, the season's operations comprising:—

(1) *In the Northern Circle*—Detail survey on the 8-inch scale of teak reserves in the Vada *taluka* of the Thana district.

(2) *In the Central Circle*—Supplementary triangulation in the Purandhar *taluka* of the Poona district; detail survey on the 4-inch scale of ordinary forest reserves in the Sirur, Bhimthadi, Indapur, and Purandhar *talukas* of the Poona district; detail survey on the 8-inch scale of the teak reserves in the Purandhar *taluka* and the *babul* reserves in the Indapur *taluka* of the Poona district, and detail survey on the 16-inch scale of the riverain *babul* reserves in the Poona district.

(3) *In the Southern Circle*—Triangulation and traversing in the Ankola and Sirsi *talukas* of the North Kanara district; and detail survey on the 4-inch scale of the forest areas in the Karwar and Yellapur *talukas*, North Kanara district.

162. The party took the field about the 10th November 1895 and returned to recess quarters at the end of May 1896, though some of the men employed in Kanara did not arrive until the middle of June.

163. In the Northern Circle, 41·4 square miles of topography on the 8-inch scale were completed in the Vada *taluka*, Thana district, in sheet No. 162.

In the Central Circle, 218·7 square miles of topography on the 4-inch scale were completed, chiefly in isolated blocks, in sheets Nos. 199, 231, 232, 233, 234, 265 and 266, all in the Poona district. In the same district and sheets, an area of 66·2 square miles of teak forest was surveyed on the 8-inch

* Mr. Erskine reports very favourably of all his assistants. The following members of the Native Establishment are also commended:—

Muhammad Zakaria, Ram Sing, Karimdad Khan, Satya Charan Ghosal, Surjan Singh, Abdul Haq (1), Abbas Ali, Sita Ram, Dharmu, Sundar Singh, Ali Hasan Khan, Baij Nath, Mahabir, Shamsul Hasan, Mohindro Nath Bose, Razi Hasan. Special mention is made of the services of the Head Writer, Syed Zille Hasnain.

BOMBAY SURVEY.

1895-96. INDEX TO THE FOREST SURVEYS IN PORTIONS OF THE NORTHERN & CENTRAL CIRCLES. No. 17 PARTY.

NORTHERN CIRCLE

CENTRAL CIRCLE

SOUTHERN CIRCLE

NIZAM'S DOMINIONS

BOMBAY

DAHANU, JAWHAR, NASIK, SINNAIR, KOPARGAON, MAHIM, WADA, IGATPURI, AKOLA, SANGAMNER, NEVASA, BASSEIN, SHAHAPUR, RAHURI, SHEVGAON, BHIWNDI, MURBAD, KALYAN, THANA, JUNNAR, AHMEDNAGAR, PANVEL, PARNER, KARJAT, KHED, SIRUR, JAMKHED, PEN, KOLABA, ALIBAG, SHRIGONDA, KARJAT, POONA, ROHA, KARMALA, SUPA, PURANDHAR, BARAMATI, MANGAON, HABSAN, MAHAD, BHOR, INDAPUR, WAI, PHALTAN, Mahabaleshwar, MALSIRAS, DAPOLI

Torna Fort, Rajgad Fort, Sinhgad Fort, Mula R., Mutha Mula R., Nira R., Bhima R.

G.I.P. Railway, B.B.&C.I. Railway, D.M. Railway, S.M. Railway

REFERENCES.

Sheets published on 1" Scale are shown thus	(200)	Surveyed during 1895-96 .... on 4" Scale	
Surveyed during previous seasons on 4" Scale		Do. do. on 2" Scale	
Do. do. on 2" Scale		Do. do. on 1" Scale	
Do. do. on 1" Scale		Area Triangulated in advance	

Scale of Miles.

10 5 0 10 20 30 40

NOTE.

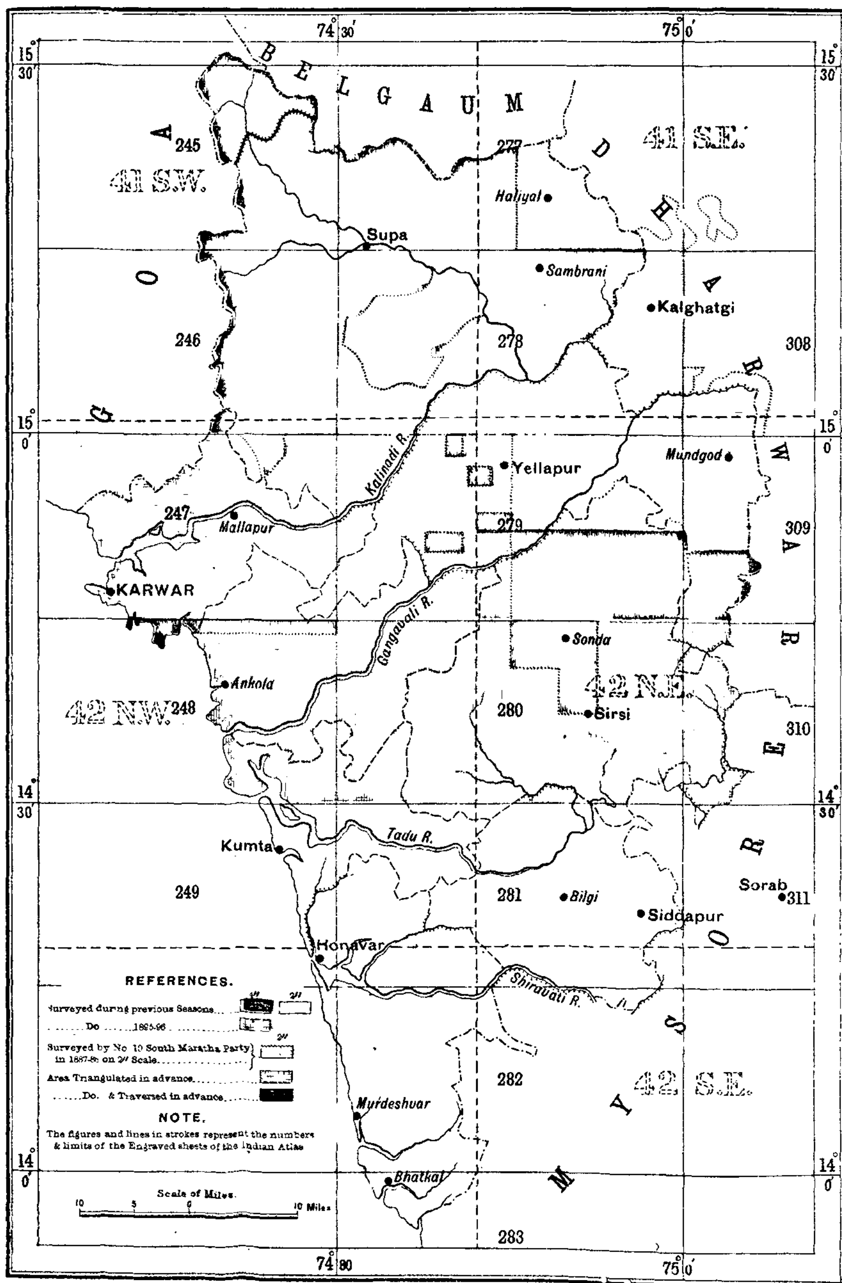
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No. 315-S. 97.

BOMBAY SURVEY.

INDEX TO THE FOREST SURVEYS IN THE SOUTHERN CIRCLE (N. KANARA).

1895-96. No. 17 PARTY.



Reg. No. 34n, S. I. P.—Dec. 96.—952

Photo., S. I. O., Calcutta.

No. 463-S. 96.

scale, whilst 14·7 square miles of the riverain *babul* reserves were surveyed on the 16-inch scale, chiefly in sheets Nos. 233, 266 and 297.

In the Southern Circle, 280 square miles of triangulation and 344 square miles of traversing were completed in sheets Nos. 248, 279 and 280 of the North Kanara district. The outturn of the 4-inch topography in sheets Nos. 247 and 279 reaches the very large aggregate of 609·8 square miles. It was hoped that the whole of sheet No. 279 would have been completed during last field season, but the unusual amount of sickness amongst the men during the latter portion thereof rendered this impossible and a few gaps have been left.

164. The aggregate outturn of each description of survey for the past and preceding field season is shown in the following statement :—

Description.	1894-95.	1895-96.
	Square miles.	Square miles.
Triangulation	1,080	505
Traversing	275	344
Topography, 4-inch scale	159	829
" 8-inch "	285	108
" 16-inch "	24	15

The total outturn of topography on all scales is considerably in excess of that for last year, whilst that of triangulation falls considerably short of the corresponding figures for 1894-95. This is due to the carrying out of the programme mentioned in para. 152 of the General Report for 1893-94 by which it was proposed to relinquish all detail surveys in the North Kanara district every third year, commencing with 1894-95, and to obtain in lieu a sufficient area of triangulation and traverse in advance for the two following seasons.

The decrease in the outturn of the 16-inch work is due to the fact that Surveyor Gopal Vishnu, who was in charge of this work, was fully occupied in furnishing points to, and checking the work of, the other men employed in plane-tabling, and did no plane-tabling himself, as well as to the more scattered nature of the blocks.

165. The average cost-rate of each description of work, as compared with that for the previous year, is shown in the following table:—

Description.	Scale.	1894-95.	1895-96.
		R	R
Triangulation	4 inches = 1 mile	8·8	7·1
Ditto	8 " "	15·0	3·5
Traversing	4 " "	29·5	12·2
Ditto	8 " "	4·8	...
Topography	4 " "	81·0	66·7
Ditto	8 " "	140·3	122·4
Ditto	16 " "	116·5	130·0

The above, with the single exception of the cost-rate for 16-inch topography, show a very considerable decrease on last year's figures, and they may here be said to have reached a minimum which it will hardly be possible to maintain in the future. The reduction in the case of 8-inch triangulation is due to the very easy nature of the country triangulated in the Akola *taluka* of the Ahmednagar district. The country was hilly and open throughout, and absolutely no clearing was necessary.

The decrease in the cost-rate of the 4-inch traversing in the North Kanara district is due to the fact that a large outturn was secured by a thoroughly competent traverser, whereas last year the work was performed by a comparatively new and untrained hand.

The reduction in the cost-rate of the 4-inch topography is solely due to the very large outturn during the season under report, *viz.*, 829 square miles, as compared with 159 square miles for 1894-95.

Of the former total, 609·8 square miles were completed in the North Kanara district at a cost-rate of R68·6 per square mile. It is hoped that an area of

about 600 square miles will be surveyed in that district during the coming field season.

It is somewhat difficult to account for the enhanced rate in the case of the 16-inch survey, the conditions as regards number of men employed, etc., being the same for the two years. The rate for the year under report is, however, a considerable reduction on the average rate of R185·5 for the years 1891 to 1894, and it is hoped that it will be lowered during next field season.

166. The arrangements mentioned in paragraph 189 of last year's General Report for the carrying out of the surveys on the 16-inch scale were continued last field season, and Surveyor Gopal Vishnu again conducted the operations in a thoroughly satisfactory manner.

167. As mentioned in paragraph 195 of last year's General Report, it was determined, as an experiment, to endeavour to demarcate the 'coupes' in the Vada *taluka*, Thana District, *pari passu* with the detail survey, and also to demarcate the 'coupes' in the blocks already surveyed in that district. The area of these blocks amounted to 95 square miles, whilst that remaining for survey in the *taluka* aggregated 41·4 square miles. The work was entrusted to Mr. S. Norman, whose camp was engaged on the detail survey of the Vada *taluka*, and sub-surveyor N. R. Patwardhan carried out the demarcation over the area previously surveyed. Of the total number of 1,360 'coupes' in the *taluka*, 1,068 were marked out on the ground by Mr. Norman's surveyors, by 2,599 cairns, and 6,873 embedded stones. The total cost for the demarcation amounted to R995-2-2, which gives an average of As. 14-11 per 'coupe' and As. 6-2 per cairn. These figures are considerably lower than those furnished for nearly the same class of work, in the same *taluka*, by the Forest Department, in the Administration Report for 1894-95, *viz.*, R5-6-8 per 'coupe' and R1-7-10 per cairn.

168. The accuracy of the season's topography was tested by 248 linear miles of check lines, though the majority of the plane-tables were carefully examined by the assistants by *in situ* fixings, the very difficult and wooded nature of the country in some portions of the work rendering the value of the check by chaining somewhat doubtful.

169. The men employed in the Northern and Central Circles suffered very little from sickness, Mr. S. Norman's camp especially keeping remarkably healthy throughout the field season. In Kanara, however, there was a great deal of fever, dysentery, etc., and with only one or two exceptions all the men in the two camps working in the district suffered heavily. Some samples of drinking water were brought from the Yellapur jungles by Mr. C. Norman and submitted to the Chemical Examiner to Government, but the analysis showed nothing particularly noxious in the water.

170. The computations pertaining to last field season's triangulation and traversing have been computed during the recess. The season's mapping reaches the large total of 115 sheets, distributed as follows :—

In the Northern Circle, 17 sections on the 8-inch scale in district Thana.

In the Central Circle, 39 sections on the 4-inch scale, 13 on the 8-inch scale of teak and other reserves, with 11 on the 8-inch and 19 on the 16-inch scales of riverain *babul* reserves, all in the Poona district.

In the Southern Circle, 17 sections on the 4-inch scale in the North Kanara district.

Of the above it is hoped that with the exception of some of the 4-inch sections of the Poona district and some arrears from last year, all will be completed and sent to press before the 1st November next. In addition, 2 sections of sheet No. 279 in district North Kanara have been drawn for reduction, and 4 triangulation charts of sheets Nos. 247, 248, 279 and 280 in the same district are in preparation for the General Report.

It is proposed to retain a small staff of draftsmen in the office during the coming field season, by which means it is hoped that all arrears of mapping, etc., will be cleared off by the 1st May next.

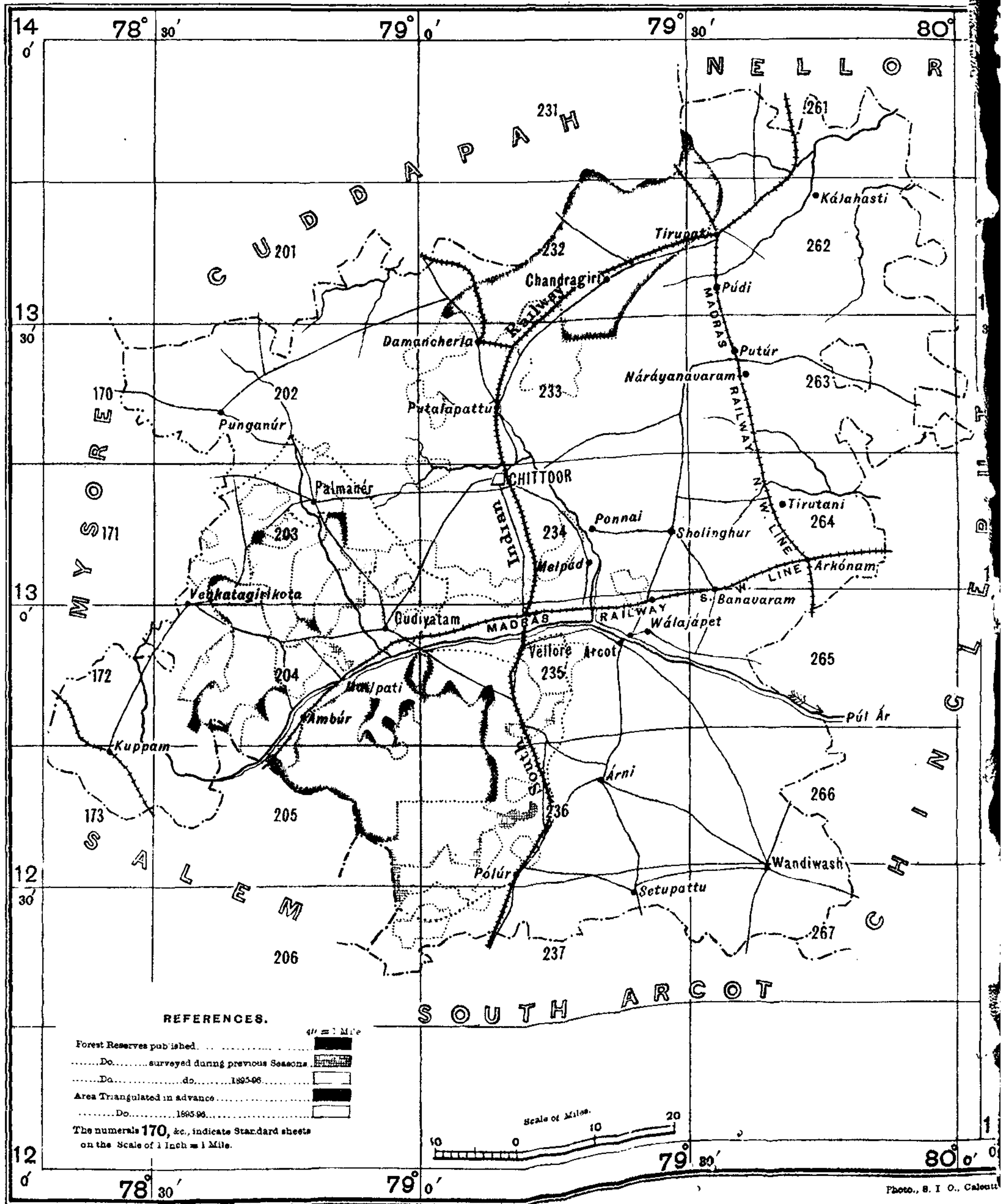
171. The programme for next field season is as follows :—

Northern Circle.—Triangulation in advance for 8-inch detail survey in the Mandvi *taluka*, Surat district; and detail survey on the 8-inch scale over an area of about 60 square miles in the Mahim and Dahaun *talukas*, Thana district, in sheets Nos. 135, 136, 161 and 162.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE NORTH ARCOT DISTRICT.

1895-96. No. 19 PA



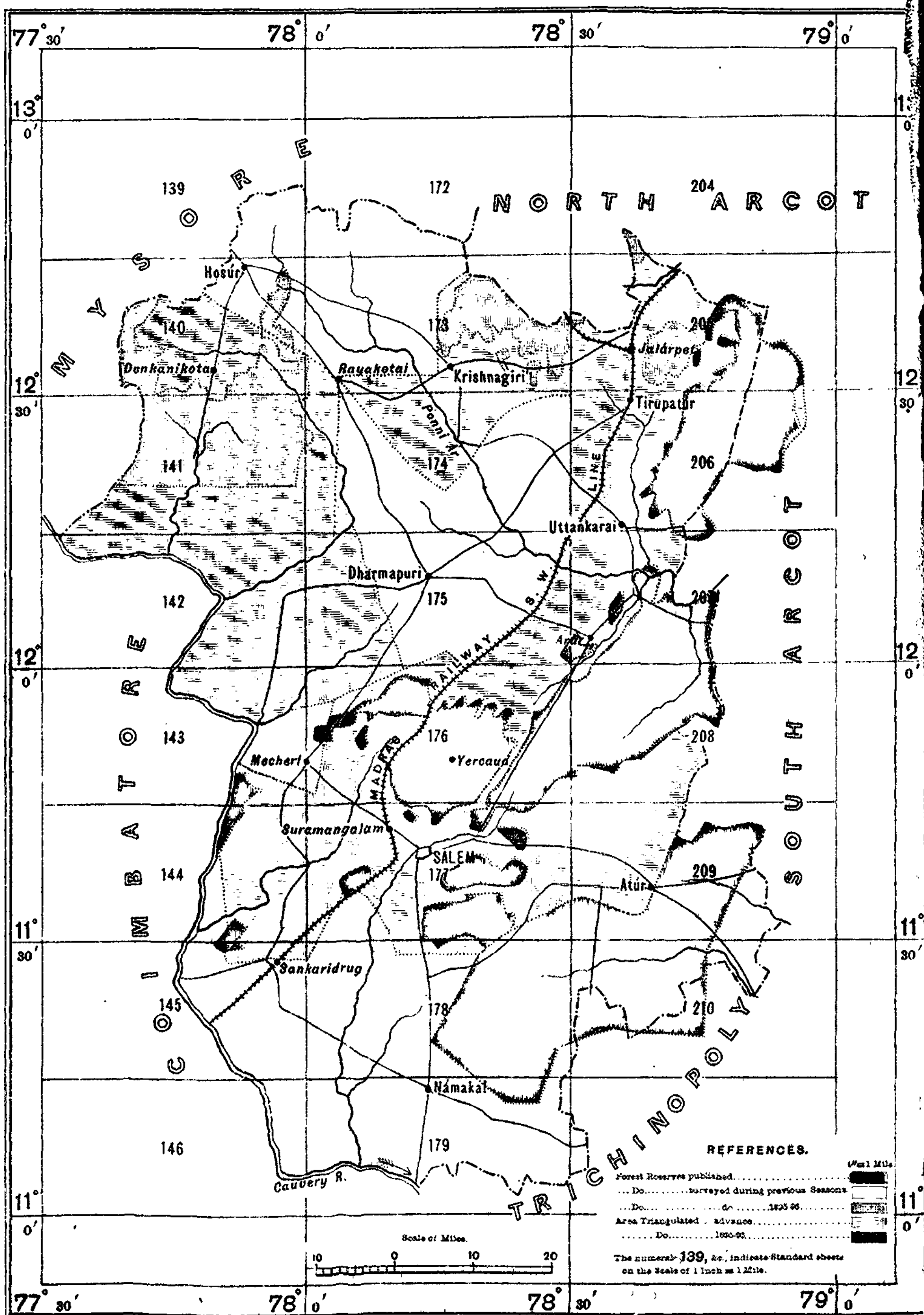
Reg No. 223, S. I. D.—Dec 96.—140

No. 466-S. 9

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE S. ARCOT & SALEM DISTRICTS.

1895-96. No. 19 PART

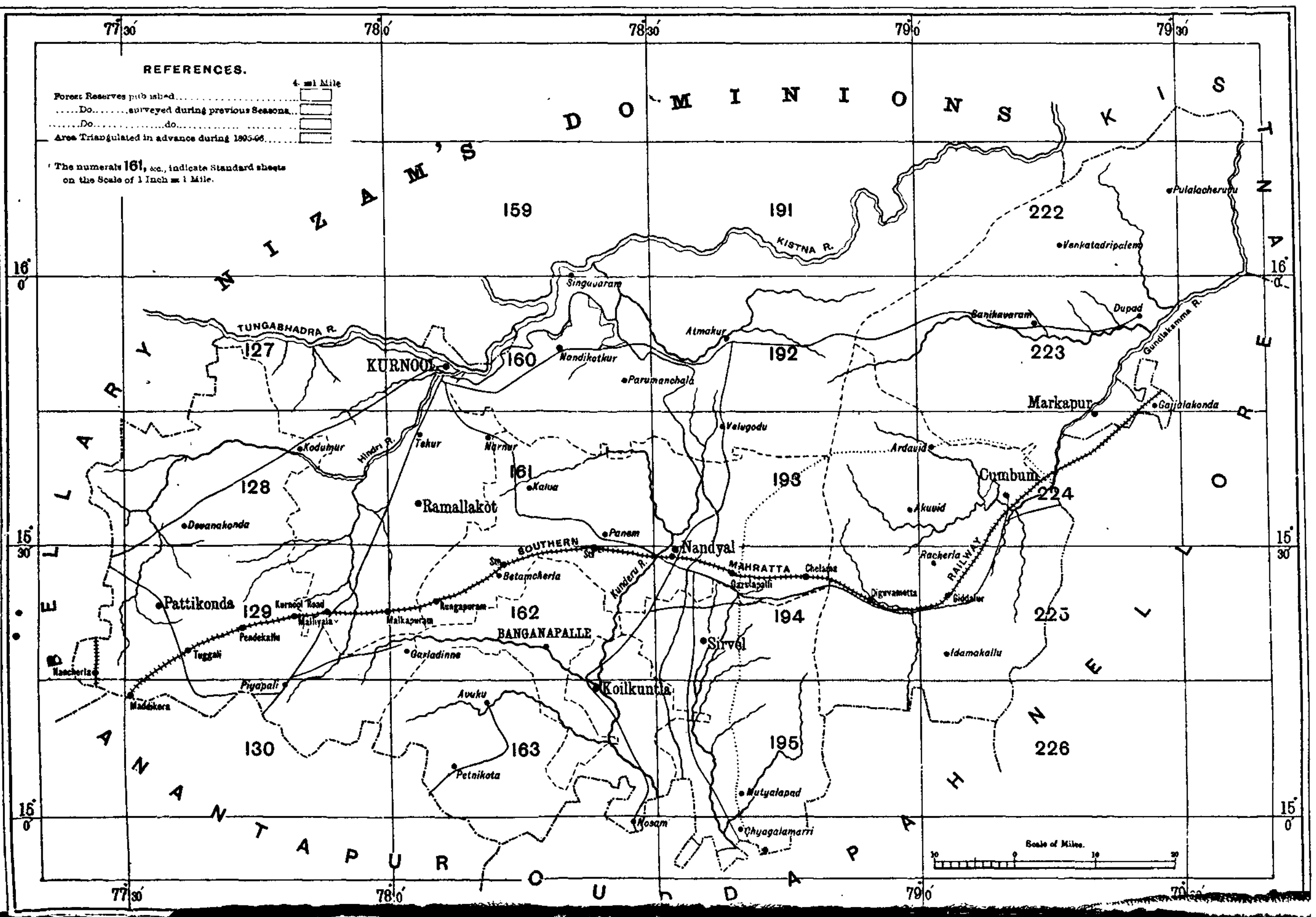


Reg. No. 223, S. I. D.—Dec. 96.—450 Photo., S. I. O., Calcutta.

No. 467-S. 96.

MADRAS SURVEY.

1895-96. INDEX TO THE FOREST SURVEYS IN THE KURNOOL DISTRICT. No. 19 PARTY.



Central Circle.—Detail survey of forests in the Akola *taluka* of the Ahmednagar district, the areas covered with teak on the 8-inch scale and the remainder on the 4-inch, over a total area of about 120 square miles in sheets Nos. 194, 195, and 228. The completion of an area of 26 square miles on the 4-inch scale remaining in the Bhimthadi *taluka*, Poona district; and detail survey of *babul* reserves on the 16-inch scale, in Ahmednagar district, over an area of about 15 square miles in sheets Nos. 227, 228, 261 and 291.

Southern Circle.—Triangulation in advance in Roha *taluka*, Kolaba district, in sheet No. 967; triangulation in advance in the Honavar and Siddapur *talukas* of the North Kanara district, in sheets Nos. 249 and 281; detail survey on the 4-inch scale over an area of about 600 square miles in the Ankola and Sirsi *talukas* of the North Kanara district in sheets Nos. 248 and 280, and completion on the same scale of a small area remaining for survey in sheet No. 279.

172. The recess office of the party was inspected at Poona on the 14th and 15th September 1896 by the Surveyor-General. Everything was found in excellent order.*

MADRAS PRESIDENCY.

No. 19 PARTY.

173. This party was employed during the season on the survey, on the 4-inch scale, of forest reserves, etc., in the Salem, North Arcot and Kurnool districts, in continuation of the work of previous seasons, and remained in charge of Lieutenant C. H. D. Ryder, R.E., throughout the year.

Personnel.

Lieutenant C. H. D. Ryder, R.E., Offg. Deputy Superintendent, 2nd grade, in charge.
Mr. C. F. Hamer, Extra Assistant Superintendent, 3rd grade.
" H. Todd, " " " 4th "
" R. Todd, " " " 5th "
" J. H. S. Wilson, Sub-Assistant Superintendent, 3rd "
" M. J. Sheehan, " " 3rd "

Surveyors and Sub-Surveyors.

Sher Shah, Bapu Jadu, Raghava Ayengar, Tiruvenketsami, Balaji Dhondiba, Govind Raju, Ramsami Naidu, and 26 others.

174. As in previous seasons, the party was divided into three sections. No. 1, under Mr. R. Todd, commenced the triangulation of the Nallamalai and adjoining hills in the Kurnool district, and Mr. J. H. S. Wilson completed the triangulation in the Salem district; Nos. 2 and 3, under Mr. Hamer and Mr. H. Todd, respectively, continued the detail survey in the Salem and North Arcot districts.

175. The field season commenced as usual in the first week in September 1895, and closed in the first week in March 1896.

176. The area triangulated amounts to 1,815 square miles,—1,200 square miles in Kurnool, 600 square miles in Salem, and 15 square miles in North Arcot; 820·1 linear miles of forest boundaries were also traversed with the theodolite. The area surveyed in detail is 964·4 square miles, being 7 square miles less than last year, the usual increase in the outturn maintained during previous years being checked temporarily owing to the reduction in the number of working members of the party, due to five apprentices lately appointed to fill existing vacancies not being fit for independent work till the close of the field season.

177. The country surveyed consists, in Salem district, of the Yellagiri hills, an isolated range; of the forests surrounding Maharajgarh hills in the Krishnagiri *taluka*; and of the forests to the south of Hosur. In North Arcot district the survey of the Javidi and outlying hills was completed, as also was that of the hills near Vellore and Gudiyatam, and other outlying hills in the Chittoor *taluka*, mostly rocky hills with only scrub jungle on them and easy of survey. The forests in the Chandragiri *taluka* were also commenced. The Nallamalai hills, in Kurnool, the triangulation of which was commenced, are densely covered with forest and will present greater difficulties to the detail surveyors than those to which they have lately been accustomed.

* Major Bythell reports very favourably of his three assistants— Messrs. Tapsell, S. Norman and C. Norman. The following members of the native establishment also deserve mention :—Gopal Vishnu, G. R. Bhopatkar, R. V. Joshi, Govind Gopal, V. G. Bhat, Ramrao Yadao, Hari Ramchandra, Moro Tukaram, R. K. Gokhle, Peter Thomas, and the writer, Hari Varman.

178. The work was tested by *in situ* fixings by the Deputy Superintendent and sectional officers, and generally found very accurate, noticeably so in Mr. H. Todd's section.

179. The health of the party was good. There was only one death amongst the *khalasis*, and the surveyors did not suffer more from fever, etc., than is to be expected when engaged on forest surveys.

180. During the recess, the computations, triangulation and traverse, were brought up to date; 19 fair sheets of the North Arcot district which had been recalled from Calcutta were completed and sent for publication, as well as 46 sheets of the 48 in which the work of the field season under report fell. The remaining two sheets, not having been completely surveyed, have been fair drawn as far as possible. There are therefore no arrears.

181. The cost-rate for the period 1st September 1895 to 31st August 1896 is R65-14-4 per square mile, showing a diminution of R0-11-0 on last year's rate, *viz.*, R66-9-4.

182. The programme for the ensuing season, as approved by the Board of Revenue, Madras, is as follows:—

Mr. R. Todd will complete the triangulation of the South Arcot district and then continue that of Kurnool. Mr. Hamer with his section will continue the detail survey in the Hosur and Dharmapuri *taluks*, Salem district. Mr. H. Todd with his section will commence the detail survey in the Kurnool district, and Mr. Wilson and three surveyors will complete that of the Chandragiri *taluk*, thus completing the survey of the North Arcot district.

183. The recess office of the party was inspected by the Surveyor General in September 1896, who was perfectly satisfied with the season's outturn and the general state of efficiency in which he found the party.*

LOWER BURMA.

No. 20 Party.

184. This party remained under the charge of Captain P. J. Gordon, S.C., throughout the year. Its programme for the season comprised—

Personnel.

Captain P. J. Gordon, S.C., Deputy Superintendent, 2nd grade, in charge.
Mr. W. A. Wilson, Extra Assistant Superintendent, 1st grade.
" P. White, " " " 3rd "
" A. Ewing, Sub- " " 1st "
" H. A. Charrier, " " " 2nd "
Thirty-two surveyors, sub-surveyors, etc.

(1) Triangulation and traverse survey in advance of forests in the Shwegyin and Pegu forest divisions to the south of Kun Chaung.

(2) Detail survey on the 4-inch scale of forest reserves in the Toungoo and Pegu districts and on the 2-inch scale of unreserved forests in the Toungoo district.

185. The party left recess quarters at Bangalore in the middle of November 1895, and commenced field work in the first week of December. The return to recess quarters was made in the first week in June 1896. Owing to the unhealthiness of the forests in the earlier part of the season and after the monsoon breaks, six months is the utmost to which the field season can be prolonged.

186. The outturn for the season is as follows:—

Triangulation	638 square miles.
Traversing	746 linear "
Topography, 4-inch	339 square "
Ditto, 2-inch	111 " "

187. The triangulation was carried on by Mr. White, who observed at 14

* Lieutenant Ryder reports very favourably of Mr. Hamer, Mr. H. Todd, Mr. R. Todd, and Mr. J. H. S. Wilson. The surveyors and sub-surveyors, with two exceptions, are well reported on, special mention being made of Surveyors Raghava Ayengar, Tiruvenketsami, Balaji Dhondiba, Govind Raju, Anantarao Dhondiba, Chinnapa Pillai, and Narain Rao.

BURMA SURVEY.

INDEX TO THE FOREST SURVEY IN LOWER BURMA.

1895-96. No. 20 PARTY.

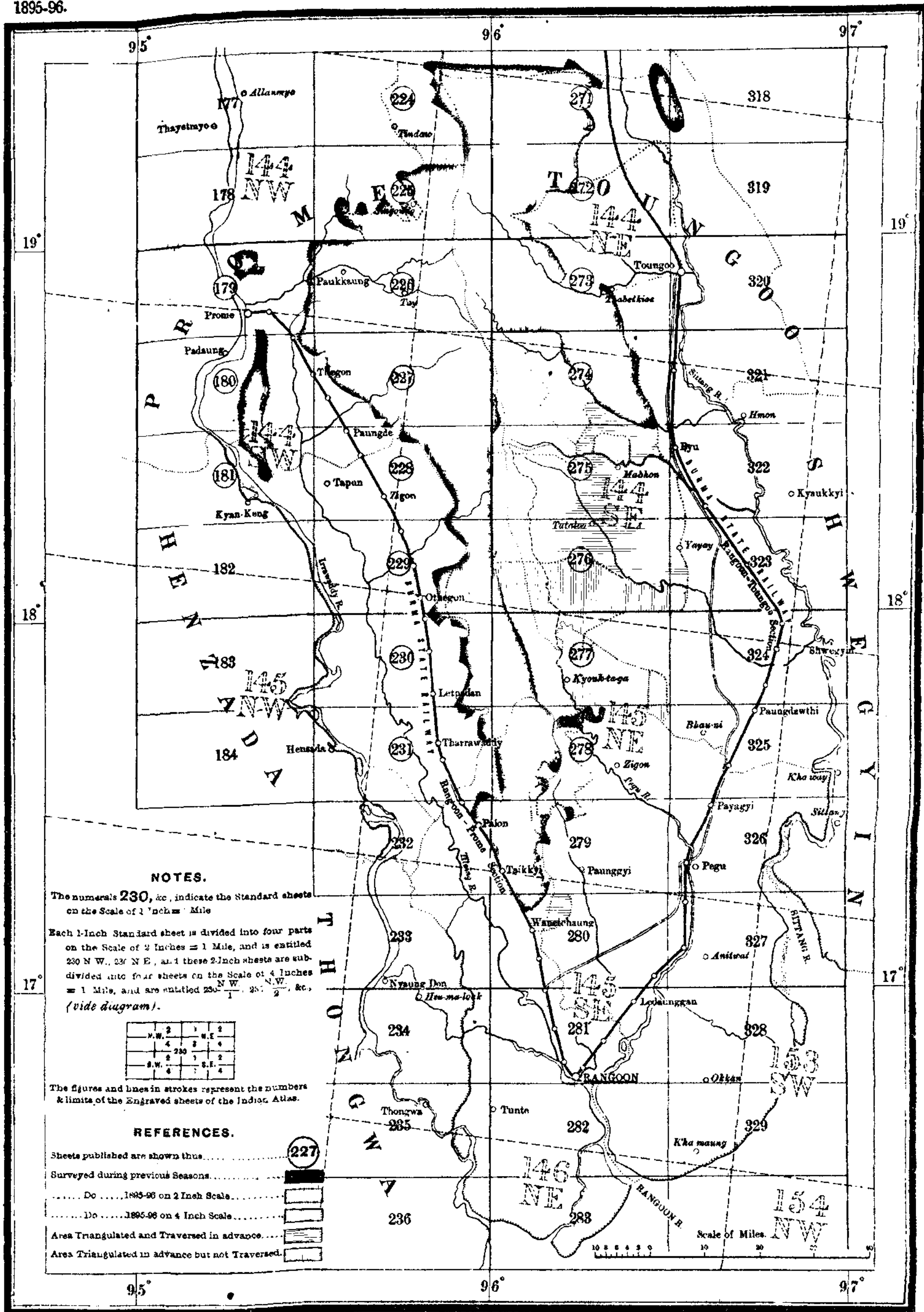


Photo., S. I. O., Calcutta.

No. 349-S. 97

stations, of which 8 were new—a very satisfactory outturn. The work was connected with five Great Trigonometrical stations.

188. The traverse work was conducted by Mr. Wilson, and shows a considerable improvement in quantity and quality. The work was checked by 153 sun azimuths, giving good results. Vertical angles were taken at all traverse stations, and by this means a large number of heights throughout the work are made available, removing the great objection there has hitherto been to the maps of this party, *viz.*, the paucity of heights. By this means, too, the average linear error was reduced by half.

189. The principal detail work in the Pyukun reserve was under Mr. Ewing. The officer in charge personally supervised the detachment working in the Paunglin group in Pegu. Mr. Charrier was employed on the 2-inch work in Toungoo district, and later on 4-inch work in Pegu and testing plane-tables. The work was systematically tested both by the officer in charge and assistants. The classification of forests and soils was continued. The outturn of 4-inch work is the same as last year, but it may be noted that the work lay entirely in the hills, whereas last season a considerable portion of it fell in level country. The outturn of 2-inch work is much in excess of last year.

190. The cost-rates continue to show in almost all cases a steady decrease, as will be seen from the following statement:—

Year.	Cost-rates per square mile.			
	Triangulation.	Traversing.	Detail survey, 4-inch scale.	Combined survey.
	R	R	R	R
1891-92	35·2	150·6	175·3	361·1
1892-93	33·2	138·1	160·1	331·4
1893-94	36·9	133·9	159·3	330·1
1894-95	30·1	94·0	153·5	277·6
1895-96	21·2	58·5	158·1	237·8

It may be remarked that the cost of a square mile does not always afford an accurate standard of comparison. A great deal depends on the nature of the country; and where in fairly open country with bold features the plane-table and theodolite are set up once, in the intricate and thickly wooded forests of Lower Burma they are set up four or five times. It is on this to a great extent, though not altogether, that the outturn depends; and if this is taken into consideration, as well as the extra expenses which have been frequently referred to in former reports, the cost-rates of this party do not compare unfavourably with those of other parties working in more favourable localities.

191. There is little to add to what has been already said in previous reports regarding the country or the climate. The work is tedious and monotonous, and although all members of the party do their utmost, the small return that is possible is most disheartening.

192. The health of the party this season was not so good as usual. One sub-surveyor and seven *khalásis* died during the field season, three *khalásis* on board ship and one shortly after his return. One *khalási* was killed by a tiger, which caused a serious scare amongst the rest and nearly brought the triangulation work to a close.

193. No supplies could be obtained in the country where the surveyors were working with the exception of a little rice. The entire supply of provisions and the distribution of them to outlying camps had to be made by the party. There was no hitch in the arrangements, although there is generally

a good deal of anxiety regarding the provisioning of surveyors working at a distance.

194. During the recess all the computations and 4-inch fair mapping were brought up to date, and twenty-four 4-inch sheets and four charts were submitted for publication.

195. The programme for next season comprises—

(1) The detail survey on the 4-inch scale of the Aingdonkun and Wunpein and part of the North Zamayi reserves; and on the 2-inch scale of about 100 square miles of unreserved forest in Toungoo district.

(2) The traverse survey in advance of the North and South Zamayi and Kadat group of reserves in the Pegu forest division, and of the Mayan reserve in Shwegyin, and of all included unreserved forests.

Sufficient triangulation exists for the remainder of the general programme of the party, and it has been decided to transfer Mr. White and the triangulation section to No. 11 Party where they can be profitably employed. The work of this party is now connected with the work of No. 7 Party in Pegu district, and their eastern and western boundaries respectively are conterminous.

196. The recess office of the party was inspected by the Surveyor General in September 1896, and the Deputy Surveyor General in charge Revenue Branch also inspected the party in the field in January 1896. The Surveyor General remarks that Captain Gordon deserves much credit for his good management, which has caused an increase in the annual outturn and a decrease in the cost-rate. Everything was found in good order by the Surveyor General at his inspection of the recess office at Bangalore in September 1896.

The Deputy Surveyor-General reports that Captain Gordon has done well with the means at his disposal, but if his establishment were stronger his cost-rate would be still further reduced. He has submitted a scheme to this effect which will be approved.*

OPERATIONS OF THE FOREST SURVEY BRANCH.

197. The Forest Survey Branch, the administration of which is under the control of the Inspector General of Forests, remained under the supervision of Mr. W. H. Reynolds, Superintendent of Forest Surveys, throughout the year.

198. The principal operations were in continuation of those of previous years and field work was extended in six districts of the Central Provinces, in the North-Western Provinces and Oudh, the Punjab, and Upper Burma. Two surveyors were also employed on the re-alignment of the Bhutan-Goalpara boundary. In addition to the above, the survey of the forests in the Attaran valley, Lower Burma, was commenced. The operations in each province will be reported on separately.

CENTRAL PROVINCES.

199. In the Central Provinces four separate detachments of the Forest Survey Branch were employed upon field operations. The Forest divisions operated on were (i) Raipur, (ii) Balaghat, (iii) Nagpur, with Seoni and Chhindwara, and (iv) Saugor, and each detachment was under European supervision, as shown in the margin.

Mr. E. Litchfield, Officiating Deputy Superintendent, 1st grade, up to 8th April 1896.
" T. S. Marten, Extra Assistant Superintendent, 6th grade.
" J. Marten, ditto do. 6th grade.
" T. H. Nichol, Sub- ditto do. 2nd grade.
" C. Litchfield, ditto do. 2nd grade.

200. The operations of all four detachments were in continuation of the operations of the previous year. The several survey detachments took the field on the 15th November and returned to recess quarters in June.

* Captain Gordon reports that the assistants in charge of camps performed their duties to his entire satisfaction. Of the native establishment the following are deserving of special mention:—Amjad Ali, Sharfuddin, Kyaw Nyein, Zahur Hasan, Alla Ditta, and Mahomed Abdul Karim.

201. The following statement shows the areas surveyed by each detachment and the cost-rate per square mile of each branch of the work :—

Forest Division.	Triangulation.		Traversing.		Levelling.		Topography, chiefly on 4-inch scale, including forest growth and soil record.		Remarks.
	Area in square miles.	Cost-rate per square mile.	Area in square miles.	Cost-rate per square mile.	Linear miles.	Cost-rate.	Area in square miles.	Cost-rate per square mile.	
		R		R		R		R	
Nagpur, Seoni and Chhindwara . .	424	14·5	...	...	...	...	223	67·9	
Jubbulpore . .	...	...	...	...	...	...	5	42·8	
Saugor . . .	380	8·0	...	...	30	8·3	215	42·4	
Raipur . . .	...	...	15	7·3	282	5·9	298	43·2	
Balaghat . .	...	...	47*	8·9	...	...	411	25·9	* Linear miles.
Total .	804	...	...	...	312	...	1,152	...	

202. In the Raipur, Balaghat, Nagpur and Seoni districts it was not found necessary to do any triangulation, as this branch of the work was well in advance of the topographical survey, nor was it found necessary to run any additional traversing except in Balaghat and Raipur.

203. In the Saugor district Mr. T. S. Marten did the triangulation, and Mr. J. H. Nichol triangulated the Chhindwara forests.

204. In the Raipur and Saugor districts, where it had not been possible to fix a sufficient number of heights by triangulation, it became necessary to use the spirit-level for the purpose of running instrumental contours.

205. In addition to running instrumental contours throughout the work at vertical intervals of 250 feet, the topography was further checked by running 547 miles of *partal* or check lines through it wherever it was possible to run a chain.

206. The expenditure incurred for the year under report for surveys in progress was R59,626 as against R52,176 expended in 1894-95, and R4,451 was expended chiefly on account of photo-zinco. and publishing charges for forest maps of the Narsinghpur and Bhandara divisions or of areas previously surveyed, making a total expenditure for the year of R64,077 as against R57,393 in the previous year.

207. The *average* cost-rate of the detail topographical surveys, including all charges, was R41·6 per square mile as compared with R50 in the previous year and R54 in 1893-94.

208. Mr. W. H. Reynolds, Superintendent of Forest Surveys, visited in turn each of the field parties; he was in the Central Provinces from the 11th to the 23rd February 1896.

North-Western Provinces and Oudh.

209. In the North-Western Provinces and Oudh, as was the case the previous year, two detachments of the Forest Survey Branch were employed, *viz.*, one in the Lalitpur district of the North-Western Provinces, and the second in the districts of Gonda, Bahraich and Gorakhpur in Oudh.

210. The Lalitpur detachment took the field under Mr. B. R. Hughes, Sub-Assistant Superintendent, on the 10th November, and returned to headquarters on the 27th March on completion of the field work of the forests in this district.

211. The topographical survey was confined to the forests in the northern part of the district, and the triangulation necessary for the survey was executed by Mr. Hughes.

212. The following statement shows the areas surveyed and the cost-rate of each class of work :—

FOREST DIVISION.	Description.	Area in square miles.	Cost-rate per square mile.
			R
Lalitpur . .	Triangulation . .	392	12·7
	Topographical survey on 4-inch scale . .	23	45·3

The cost-rates for similar work done during the previous year were : triangulation R9·4 per square mile and topographical survey on the 4-inch scale R55·3 per square mile.

213. The amount expended on the season's operations including the mapping and all other charges was R6,041 as against R8,692 in the previous year.

214. Mr. W. H. Reynolds, Superintendent of Forest Surveys, was in the Lalitpur district from the 7th to the 11th February and satisfied himself that the accounts of the detachment were well kept and the field work efficiently conducted.

215. On completion of the survey of the forests in the Lalitpur district Mr. B. R. Hughes was re-transferred, on the 24th April, to the Survey of India Department. Mr. Hughes is an officer of much promise, and did good work whilst attached to the Forest Survey Branch.

216. In Oudh the forest survey operations were in continuation of the previous year ; the detachment took the field on the 8th November and returned to recess quarters about the middle of June.

217. This detachment worked under Babu Odey Singh, a native assistant of considerable experience and a trustworthy surveyor. The Superintendent visited the detachment whilst in the field from the 6th to the 15th March and closely scrutinized the details of the season's work, and was satisfied that they had been carefully done.

218. During the early part of the field season traversing was carried on in the Gonda and Bahraich districts, and the 4-inch topographical survey of the forests in the above two districts as well as in Gorakhpur was completed by the close of the season.

219. The following statement shows the season's outturn as well as the cost-rate of each class of survey :—

FOREST DIVISION.	TRAVERSING.		4-INCH TOPOGRAPHY AND FOREST GROWTH RECORDS.	
	Area in square miles.	Cost-rate per square mile.	Area in square miles.	Cost-rate per square mile.
		R		R
Gonda	7	9·0	22	18·4
Bahraich	44		198	
Gorakhpur	...	...	178	
TOTAL AREA .	51	...	398	...

220. One hundred and thirty-nine miles of *partal* or check survey lines were run through the detail work to test the accuracy of the topographical survey.

221. The total expenditure on account of the Oudh surveys amounted to R8,947 as against R10,596 in the previous year. Included in these figures is the sum of R1,149 chiefly on account of photo-zinco. and publishing maps of surveys done in previous years.

PUNJAB.

222. The survey, which was commenced in the previous year, of the Chamba State and the forests leased by the Punjab Government in that State, was continued during the year under report. The leased forests are being surveyed on the 4-inch scale, and the rest of the Chamba State is being mapped, for topographical purposes, on the 1-inch scale.

The surveyors were in the field for various limited periods at such times as it was possible to continue field work in the Himalayas or when the work could be safely carried on without fear of interruption from the snow in the winter, or the heavy rains during the summer, months.

223. Triangulation was extended up the Ravi Valley to the borders of Kangra on the east and on the north to the outer snowy range or watershed of the Ravi and Chandra Bhaga rivers.

224. Topographical operations, on the 1-inch scale, were carried on chiefly in the southern and western tracts of the Chamba State, and the 4-inch survey was confined chiefly to the forests in the Bhandal and Chamba Ranges. In the 4-inch detail survey instrumental contour lines have been measured at 250 feet vertical distances and in the 1-inch work the contours are shown at 1,000 feet vertical intervals.

225. The following statement exhibits the areas surveyed during the year as well as the cost-rates of each class of survey:—

STATE.	Description.	Area in square miles.	Cost-rate per square mile.
			R
Chamba . .	Triangulation . .	1,165	3·0
	Topographical survey, 4-inch scale.	92	36·9
	Ditto ditto, 1-inch.	621	11·5

The expenditure on account of the survey operations in the Chamba State was R14,020, and R1,849 were expended on account of mapping and photo-zincographing sheets of the Bashahr State, making in all a total expenditure of R15,869 on forest survey operations in the Punjab.

226. Mr. W. H. Reynolds, Superintendent of Forest Surveys, was in the Chamba State during October and again from May to July, personally directing the survey operations, and Mr. E. Litchfield, Deputy Superintendent, was with the Chamba Party from the 16th of April to the 14th August, examining and testing the topographical work that had been previously done and supervising the current field work.

BURMA.

227. In Burma, operations by the Forest Survey Branch were carried on in the Pyinmana division of Upper Burma and in the Attaran forests of the Tenasserim Circle in Lower Burma.

228. The Pyinmana detachment was employed on traversing and 4-inch detail survey, and that in the Tenasserim Circle was engaged entirely on the preliminary work of triangulation and traversing as a basis for the following season's topographical survey. The general arrangements for the survey establishments were under the supervision of the Deputy Conservators of the Pyinmana and Salween-Attaran Forest Divisions.

229. The surveyors left head-quarters in November and field work was commenced by the middle of December; the two detachments returned to recess quarters early in June.

230. The following statement shows the areas completed and the cost-rate of each class of survey:—

Forest Division.	Triangulation.		Traversing.		Topography 4-inch scale and record of Forest growth.	
	Area in square miles.	Cost-rate.	Area in square miles.	Cost-rate.	Area in square miles.	Cost-rate.
		R		R		R
Tenasserim	560	7·4	399	19·0	...	...
Pyinmana	...	...	65* *(linear miles).	31·3	174	91·9

231. The detail survey was tested by running 60 linear miles of *partal* through the work after it was completed.

232. The expenditure on the above operations, including the season's mapping and all other charges, amounted to R29,792 as against R26,089 in the previous year and R29,095 in 1893-94.

233. Mr. W. H. Reynolds was in Burma during the greater part of January, and visited in turn the two field detachments and satisfied himself that suitable arrangements had been made for the several survey camps, and that the several branches of the work were progressing satisfactorily.

234. Further particulars of the work carried on by the Forest Survey Branch and index maps illustrating the same, will be found in the report on the operations of the branch, published under the direction of the Superintendent of Forest Surveys.*

CADASTRAL SURVEYS.

SHWEBO, YAMETHIN, KATHA, ETC., DISTRICTS, UPPER BURMA.

No. 3 Party.

235. Mr. G. H. Cooke held charge of this party throughout the year. Its programme was again a most varied one, being scattered over localities widely separated from each other and extending over six districts.

Personnel.

Mr. G. H. Cooke, Superintendent, 2nd grade, in charge.		
„ E. G. Little, Extra Assistant Superintendent, 3rd grade.		
„ J. Connor,	ditto,	4th grade.
„ G. C. Swiney,	ditto,	5th grade.
„ C. W. Wilson,	ditto,	5th grade.
„ A. George, Sub-	ditto.	1st grade.
„ P. J. Serrao,	ditto,	1st grade.
„ W. J. Baker,	ditto,	2nd grade.
„ O. C. Ollenbach,	ditto,	2nd grade.
„ W. Newland,	ditto,	2nd grade.
Babu H. K. Roy,	ditto,	3rd grade.
52 surveyors and sub-surveyors.		
12 inspectors.		
120 field surveyors (Indian).		
36 ditto, (Burmans).		

236. The work of the season comprised:—

(1) The traverse and cadastral survey of about 193 square miles to complete the Shwebo district.

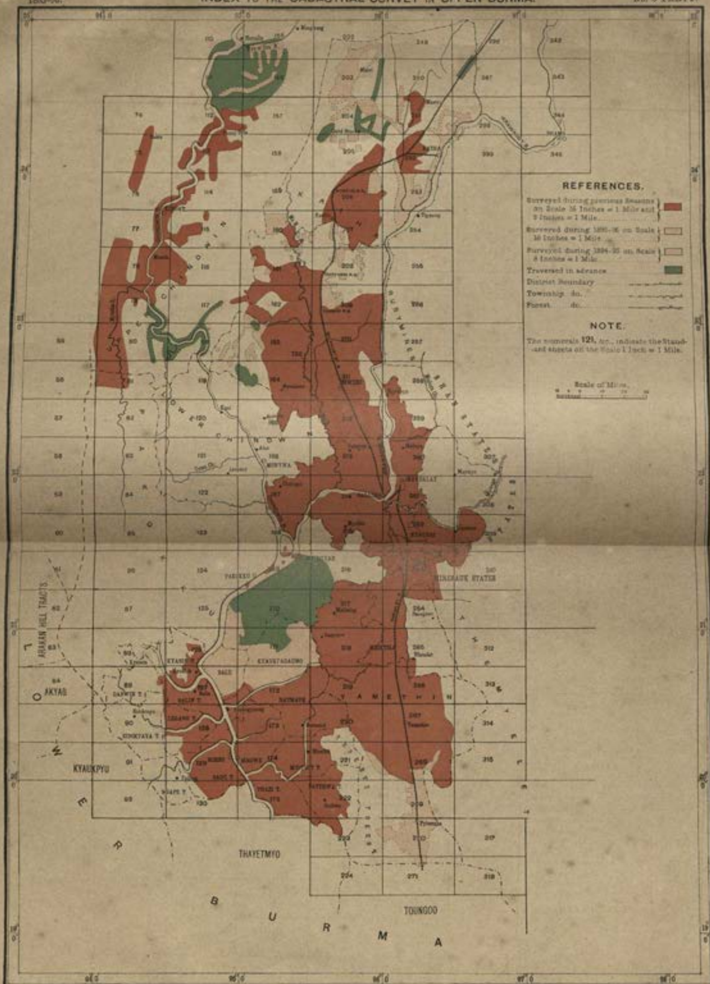
(2) The traverse and cadastral survey of about 450 square miles to complete the Yamethin district.

(3) The continuation of traverse and cadastral survey in the Katha district.

(4) The continuation of traverse and cadastral survey in the Upper Chindwin district.

* Mr. Reynolds reports favourably on all his assistants; he specially mentions Mr. J. Marten as having performed his duties in the field and in office with credit, and Messrs. J. H. Nichol and C. Litchfield as having shown themselves most zealous in the discharge of their duties.

The native surveyors have on the whole worked very satisfactorily both in the field and in recess, and the following have been selected for special mention:—Salig Ram, Bhoop Singh, Odey Singh, and Dalip Singh.


BURMA SURVEY.
INDEX TO THE CADASTRAL SURVEY IN UPPER BURMA.
1895-96.
No. 3 PARTY.
REFERENCES.
Surveyed during previous Seasons on Scale 16 Inches = 1 Mile and 8 Inches = 1 Mile
Surveyed during 1895-96 on Scale 16 Inches = 1 Mile
Surveyed during 1894-95 on Scale 8 Inches = 1 Mile
Traversed in advance
District Boundary
Township do.
Forest do.
NOTE.
The numerals 121, &c., indicate the Standard sheets of the Scale 1 Inch = 1 Mile.
Scale of Miles.
ARAKAN HILL TRACTS
AKYAB
KYAUKPYU
THAYETMYO
TOUNGOO
MANDALAY
MEIKTILA
YAMETHIN
KYAUKSE
MYINGYAN
PAKOKKU
CHINDWIN
SHAN STATES
LOWER BURMA
No. 301-S. 97.

(5) The continuation of traverse survey and commencement of cadastral survey in the Myingyan district.
(6) The survey of the boundary between Upper Burma and Manipur.
(7) The revision survey of certain villages in the Kale Kubo valley, Upper Chindwin district, which on being checked was found to be false.
(8) The survey of a portion of two gold-prospecting blocks in the Katha district.
(9) The re-drawing of the circle maps of the Shwebo district by *kwins*, and the re-casting of area statements of the same, on account of the demarcation of the district not having been effected till after survey.
(10) The adjustment and alteration of plans and area statements of the Meiktila, Sagaing and Minbu districts, in which settlement operations are in progress in consequence of changes made subsequent to survey.

237. Field operations commenced about the end of November 1895 and continued until the end of May 1896, except in the Pyinmana subdivision of the Yamethin district, where the work was continued until the end of June in in order to complete the district.

238. The work in each district will be reported on separately.

Survey of the Shwebo District.

239. The whole area of this district which has come under cadastral survey during 1894-96 has been demarcated by *kwins* in advance of the survey, and the greater part of it has been surveyed in traverse polygons. But large tracts of country to the north of the district contained so little cultivation that after referring the matter to the district authorities it was decided to embrace by the traverse lines the cultivated areas only which were required for assessment purposes, and to omit the jungle tracts. This system saved an immense amount of unnecessary labour, and enabled the cadastral survey of the district to be completed this season, with the exception of 22 outlying villages in jungle tracts on the outskirts of the district which had been omitted in season 1893-94.

240. The cadastral survey covered a scattered area of 193 square miles which was checked by 103 linear miles of independent *partal* and 10 linear miles of inspector's *partal*. This area has been mapped on 466 sheets, and of these sheets, tracings and area statements have been made for the Settlement Department. The area surveyed contains 141 square miles of cultivation and 52 square miles of jungle, and is very much scattered on the outskirts of the district, which made the control of the work very difficult.

241. The traverse survey done in this district covers an area of 246 square miles, in which 718 linear miles of chaining were run, and 5,123 angles observed, checked by 14 observations for azimuth. Connections were made to 3 Great Trigonometrical stations, the results of which prove well.

Survey of the Yamethin District.

242. This district, including the subdivision of Pyinmana, has been demarcated by *kwins* in advance of the survey, by demarcation officers appointed for the purpose, and the whole district has been surveyed *kwin* by *kwin* in polygons, with the exception of the Kyidaing circle of the Paunglaung township, the demarcation of which was found to have been omitted when the traverse surveyors came on the ground. The matter was brought to the notice of the Settlement Officers and steps have been taken to lay down the boundaries.

243. The area remaining for cadastral survey in the district was 452 square miles, and this was completed with the exception of the undemarcated area above referred to. The tract surveyed contains 449 *kwins* which have been mapped on 640 sheets; of the total area 346 square miles are cultivated and 106 square miles are jungle and low hills. The detail survey has been checked by 239 linear miles of independent *partal* and 258 linear miles of inspector's *partal*. Traces and area statements of the whole area were furnished to the Settlement Department.

244. The area traversed is 455 square miles, and contains 1,805 linear miles of chaining. The number of angles observed is 16,113 and of observations for azimuth 77. Connections were made with three Great Trigonometrical stations.

Survey of the Katha District.

245. As mentioned in last year's Report, no demarcation of *kwins* has been done in this district. The traverse lines embrace the cultivated areas only, and the cadastral survey has been made in blocks, each map containing the land under the control of one headman.

246. The area traversed covers a tract of country of 152 square miles, with 1,203 linear miles of chaining. The number of angles was 11,496, and these were checked by 115 observations for azimuth. Connections were made with three G. T. stations, with fair results, the error per mile being 1·5 feet.

247. The area of actual cultivation surveyed on the 16-inch scale was not more than 142 square miles, but this area was scattered within nearly 3,000 square miles of country, which made the control of the work exceedingly difficult and the traversing very heavy, as each separate block of cultivation requires to be connected by traverse lines which had to be run through extensive tracts of jungle, sometimes over rough and rugged country.

248. The area surveyed is mapped on 402 sheets, which have been tested by 150 linear miles of independent *partal* and 148 linear miles of inspector's *partal.*

Survey of the Upper Chindwin District.

249. As in Katha, no demarcation of *kwins* has been done in this district, and only the cultivated areas have been traversed. The area traversed was 200 square miles, containing 1,434 linear miles of chaining and 10,449 angles, which were checked by 109 observations for azimuth. Connections were made with six G. T. stations with fair results.

250. The area cadastrally surveyed amounts to 133 square miles, of which 32 square miles is new work and the remainder revision of the work of 1893-94, in the Kale Kubo valley. The cadastral area is scattered over about 1,600 square miles of country on both banks and in lateral valleys of the Chindwin river. The supervision of this small area, scattered over such a large extent of country, and the traversing of it, was most laborious and difficult. The survey has been mapped on 187 sheets, divided off into 187 so-called *kwins*, containing blocks of cultivation under the control of one headman. The detail survey has been tested by 254 linear miles of independent *partal* run by European and native agency. This gives an average of 168 chains of check lines to each square mile of survey, exclusive of inspector's *partal.*

251. The bulk of the cultivated and revenue-paying areas of the district has been cadastrally surveyed, and the remainder will be completed during the ensuing season.

Survey of the Myingyan District.

252. The demarcation of *kwins* was done in this district in advance of the survey, but no rough traces were supplied to the Survey Department as guides to the traverse surveyors in tracing up the *kwin* boundaries. The natural boundaries of the country, such as streams, ridges, roads and paths, have generally been adopted as the *kwin* limits wherever this was possible, and a polygonal survey was made throughout the district. Each headman's circle contains from 5 to 10 square miles, and each circle has been divided off into 5 to 10 polygons or *kwins* of about one square mile each. This gives a compact area of country for each map, which is generally contained upon one sheet, or at the most two sheets, of paper.

253. The traverse survey was commenced by No. 12 Party in 1894-95, and on the transfer of that party to India, about 1,000 square miles of advance traverse work was made over to No. 3 Party for cadastral survey. During the past season an area of 955 square miles was traversed on the main land, and 208 square miles of the Irrawaddy river area, which has been traversed for the purpose of laying down the numerous islands, many of which are cultivated during the dry season. The traversing contains 3,175 linear miles and 14,568

angles, which have been checked by 54 observations for azimuth. Double chain measurements (with one long and one short chain) were run throughout the work, and the chains were regularly tested. The number of permanent marks laid down in this district this season is 14,568, traces showing the positions of which have been made and sent to the Deputy Commissioner for distribution to the headmen of circles, with a view to their preservation.

254. The area cadastrally surveyed was 1,187 square miles, which has been mapped on 1,505 sheets, and contains 1,068 *kwins*. Tracings and area statements were prepared for the Settlement Department. The cadastral area was tested by 1,622 linear miles of independent *partal*, giving an average of 109·3 chains to the square mile. In addition 1,189 linear miles of *partal* were run by inspectors.

255. The country surveyed this season contains some open plains of upland cultivation and scattered patches of wet cultivation irrigated from tanks and wells; but the greater part of the country is rough and broken up into low undulating hills covered with thorny jungle interspersed with ill-defined upland cultivation on a poor and gravelly soil. The actual area of cultivation was 743 square miles, and that of jungle, waste and hills was 444 square miles. The want of water in the greater part of the area under survey and the scanty rainfall throughout the district caused considerable difficulty in carrying on the work.

Survey of the Burma-Manipur boundary.

256. At the request of the Secretary to the Chief Commissioner, a boundary surveyor was deputed to make a plane-table survey, on the 1-inch scale, of the disputed boundary between Upper Burma and Manipur, and he was placed under the orders of the Political Agent of Manipur and the Deputy Commissioner of Upper Chindwin. The disputed boundary extended from Kongal Thana to Nataung, a distance of about 62 miles. Thirty-nine masonry pillars were erected at salient points on the boundary line by the Political Agent, and fixed by interpolation by the surveyor. A trace of the boundary has been made, together with a sketch of a narrow strip of country extending to half a mile on either side, showing the general run of the country. These were submitted to the Political Agent of Manipur.

Survey of gold-mining blocks in Katha District.

257. Only two gold-prospecting blocks were surveyed this season,—one for Messrs. Heyt & Co., and one for Mr. G. S. Hervey,—as the sub-surveyor who was told off for this work was called away for the survey of the Burma-Manipur boundary. There being no other man available, the survey of these blocks has been postponed until next season. There are at present five applications filed in the office of the party for maps of gold-prospecting blocks in the Katha district sanctioned by the Deputy Commissioner. These will all be surveyed next season if possible.

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258. The traverse surveys executed this season in all districts amount in the aggregate to 2,008 square miles, *viz.*, in Shwebo, 246 square miles; in Yamethin, 455 square miles; in Katha, 152 square miles; in Upper Chindwin, 200 square miles; in Myingyan, 955 square miles; and in the gold-fields, 2 square miles. Of this area, 1,118 square miles have been cadastrally surveyed this season, leaving a balance of 890 square miles of advance traverse for the coming season.

All traverse stations with a few exceptions in the Upper Chindwin district, where the traverse lines run through extensive jungle tracts, have been marked with baked clay or zinc cylinders; in these jungle tracts, where traverse lines have been run merely to form a circuit or connect distant blocks of cultivation, pegs have been used in place of cylinders to save cost and labour. The total number of cylinders laid down was 57,749. The number of azimuths observed was 369, and 16 connections were made with Great Trigonometrical stations to check the linear measurements. The average error per mile is 2·9 feet.

259. The total outturn for the season is shown in the following table :—

Localities.	Traverse Survey.		Cadastral Survey, 16 inches = 1 mile.			Remarks.
	Number of villages.	Area in square miles.	Number of villages.	Number of fields.	Area in square miles.	
Shwebo	188	246	188	72,071	193	
Yamethin	449	455	449	131,997	452	
Katha	330	152	330	198,877	142	
Upper Chindwin	83	200	83	36,954	32	
" " (revision survey)	...	...	104	148,448	101	
Myingyan	1,068	955	1,068	290,205	1,187	
Katha (gold-fields)	...	2	...	...	2	Surveyed on 8-inch scale.
Totals	2,118	2,010	2,222	878,552	2,109	

In addition to the above, 174 square miles of contouring on the 2-inch scale and 18 square miles on the 16-inch scale were carried out, besides 62 linear miles of boundary survey on the 1-inch scale along the Burma-Manipur boundary.

260. Revised traces and area statements of *kwins* of the Shwebo district, comprising 25 lakhs of fields and covering an area of 3,069 square miles, have been made for the Settlement Department and for the Head-Quarters Office, Calcutta, during the season. These alterations on the 16-inch congregated *kwin* maps have necessitated the re-drawing of 25 of the 2-inch graticule sheets. Traces of 13 sheets on the 4-inch scale have been made for the Irrigation Department in the Yamethin district. From the above it will be seen that the office work of the party has been unusually heavy.

261. The cost-rates per square mile of traverse and cadastral survey in each district are as follows:—

Shwebo, R162·7; Yamethin, R136·4; Katha, R161·4; Upper Chindwin R203·2; Myingyan, R135·0.

262. The average size of the field for the whole of the season's work is 1·72 acres.

263. The health of the party was poor at the commencement of the season, but improved as it advanced. The percentage of casualties was small on the total number of men employed.

264. The following maps have been prepared during the season on the 16-inch scale, with traces and area statements, for the Settlement Department :—

In Shwebo, 466 sheets; in Yamethin, 640 sheets; in Katha, 402 sheets; in Upper Chindwin, 187 sheets; and in Myingyan, 1,505 sheets,—making a total of 3,200 sheets.

Standard sheets on the 2-inch scale have been prepared as follows:— In Shwebo, 24 sheets; in Yamethin, 14 sheets; in Katha, 31 sheets; and in Myingyan, 15 sheets, or a total of 84 sheets, for publication on the 1-inch scale.

265. Relations with the district authorities and Settlement Officers were of the most cordial nature, and assistance was granted whenever it was applied for. The Settlement Officers were in constant communication with the Survey Officers regarding alterations and changes in the maps which were under settlement operations, and everything went smoothly and well.

266. The Deputy Surveyor General, Revenue Branch, inspected the party in the field in February 1896, and visited the Pyinmana, Shwebo, Katha and Upper Chindwin camps.*

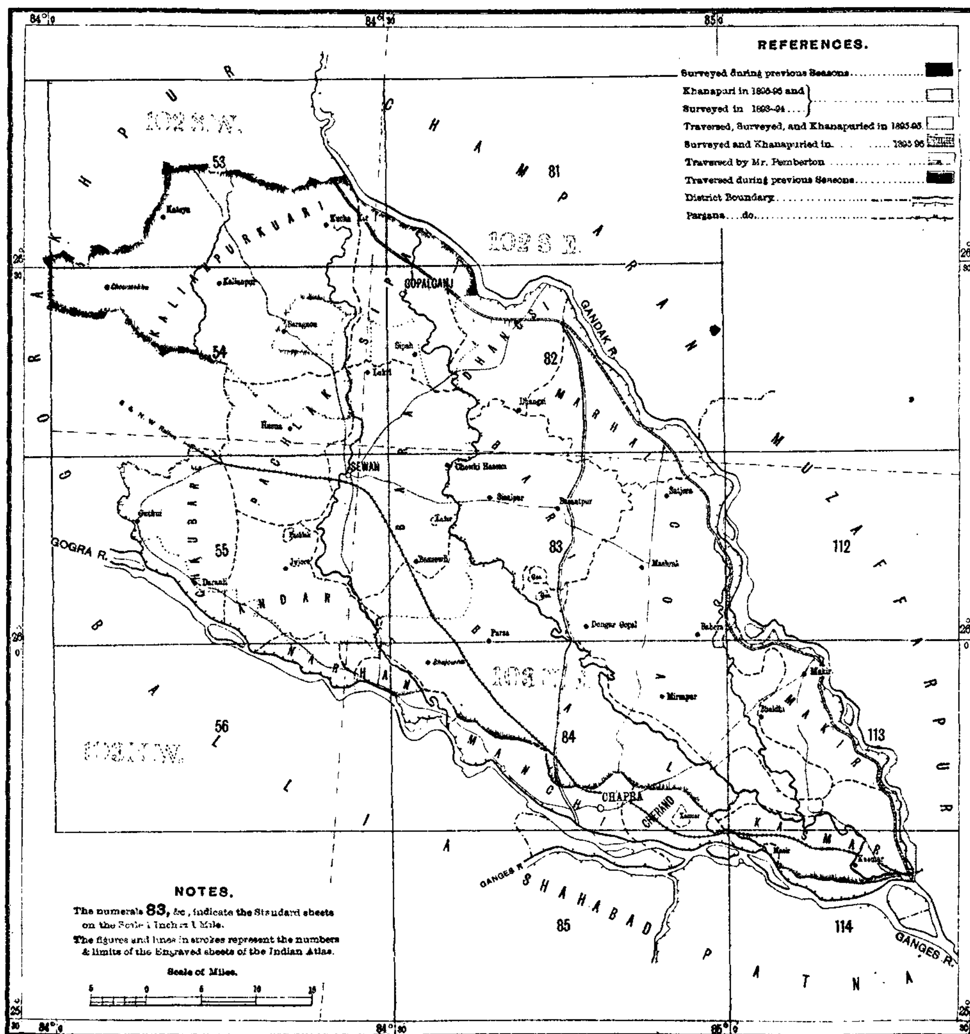
* Mr. Cooke reports that the European assistants of the party have one and all worked well throughout the season, and have satisfactorily carried out the various duties allotted to them.

Amongst the native establishment the following deserve to be commended:—Bhagobutty Charan Chuckerbutty, Pundit Kedar Nath, Surfuraz Khan, Mahomed Nisarally, Bhola Nath, Srikisto Chatterjee, Srikanto Banerjee, Rohan Lall, Gafur Bux, Lahori Singh, Maung Sai Nyo, Ram Sarup, Rafatulla, Maung tha Aung, Jai Jaikrishna, and Ajodhya Pershad.

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEYS IN DISTRICT SARAN.

1895-96. **Nos. 4 & 5 PARTIES.**



Reg. No. 487, S. I. D.—Dec. 96—1,050

Photo. S. I. O., Calcutta

No. 460-S. 96.

BIHAR.

Nos. 4 and 5 Parties.

267. These parties continued the survey of Northern Bihar in the districts of Saran, Champaran, Muzaffarpur and Darbhanga. The survey of the Government estates in district Gaya was also continued, and new surveys were commenced in the Belkhara mahal, districts Gaya and Patna, and in the Narhan Ward's estates, district Monghyr. Large-scale surveys of the Bettiah Municipality, in district Champaran, and of the Lalganj and Sitamarhi Municipalities in district Muzaffarpur, were also undertaken. Surveys were also made of the disputed boundary in *mauza* Tintanga, Bhagalpur district. The charge of the parties was held throughout the year by Lieutenant Symonds, and they were under the administrative superintendence of Captain R. T. Crichton, S.C., Superintendent of Settlement Surveys, Bengal.

Personnel.

Lieutenant C. W. H. Symonds, S.C., Assistant Superintendent, 1st grade, in charge.
Mr. H. T. Hanby, Extra Assistant Superintendent, 3rd grade.
" R. B. Smart " " " 4th "
" J. McHatton, " " " 5th "
" G. T. Hall, " " " 5th "
" A. W. Smart, " " " 6th "
" C. S. Kraal, " " " 6th "
" E. F. Berkeley, Sub- " " 1st "
" C. G. Lee, " " " 1st "
" C. S. Gasper, " " " 2nd "
Babu Sarat Chander Sen, Sub-Assistant Superintendent, 2nd grade.
" Nilmony Chatterji, Sub-Assistant Superintendent, 2nd grade.
Mr. H. H. B. Hanby, Sub-Assistant Superintendent, 2nd grade.
" P. K. Vaughan, Sub-Assistant Superintendent, 2nd grade.
3 supervisors.
8 head inspectors.
28 surveyors and sub-surveyors.
84 inspectors.
23 computers, etc.
414 *amins* (local).
429 ditto. (imported).

The operations in each district will be described separately.

Survey of the Saran District.

268. *Traverse survey.*—The traverse operations in this district were confined to the *diara* lands along the River Gogra, which were to be surveyed cadastrally during the season. The following statement shows the area accomplished :—

District.	Number of village circuits.	Number of stations.	Area in square miles.
Saran	37	558	51·68

The total number of linear miles of new chaining was 150. Two observations for azimuth were taken. As the area traversed consisted of alluvial lands no permanent marks were embedded, the stations being marked by wooden pegs. Much delay was caused by sickness, but no other difficulties worthy of mention were met with. The arrears in the traverse computations of previous seasons were brought up to date, and the work of the season under report was completed in all respects, and the establishment was transferred to the Darbhanga district. The cost-rate per square mile of the traverse survey, including completion of arrears, was R56.

269. *Cadastral survey and record-writing.*—A large cadastral section was employed under Mr. J. McHatton in this district. Field work commenced on 1st November 1895 and continued till 10th May 1896, when the section retired to recess quarters at Bankipore. The area of cadastral survey and record-writing is shown in the following statement :—

District.	Cadastral Survey, 16 inches = 1 mile.			Record-writing.		
	Number of villages.	Number of fields.	Area in square miles.	Number of villages.	Number of fields.	Area in square miles.
Saran . .	1,204	1,260,830	644·73	1,234	1,305,777	669·25

The excess in record-writing over survey of 30 villages is due to completion of arrears of record-writing of season 1893-94. The area surveyed has been mapped on 1,189 sheets. The average size of the field is 0·33 of an acre.

270. In the area surveyed, 880 linear miles of check survey were run by European officers and "independently," and 1,463 linear miles by inspectors, giving an incidence of 3·63 linear miles of check survey to each square mile of detail survey. The number of entries checked in the field records by European officers was 8,885, and by inspectors 163,167, giving an average of 13·1 per cent. of the whole number of plots. In addition to the above, the entries against 8,326 plots were tested by the Assistant Settlement Officers.

271. The demarcation, which was done by the inhabitants themselves prior to the cadastral survey, was on the whole very satisfactory, and the old revenue survey *mauza* has in every case been adopted as the unit of the record-writing. The traces and records of the entire season's outturn were completed and despatched to the Settlement Department. The cost-rate of the cadastral survey, etc., was R71, and for record-writing, etc., R76, per square mile. The rate for the cadastral survey includes the expenditure on coolies, which alone amounts to R10-7-6 per square mile.

272. The areas completed up to date in this district in traversing, cadastral survey and record-writing are as follows:—

Year.	Areas completed in square miles.		
	Traverse survey.	Cadastral survey.	Record-writing.
1892-93	894	...	...
1893-94	932	549	528
1894-95	516	...	...
1895-96	52	648	669
	2,394	1,197	1,197

Taking the whole area of the district to be 2,622 square miles, as given by the former revenue survey, there remains for traverse survey 228 square miles, all of which is in *diara* lands; and for cadastral survey and record-writing 1,425 square miles, of which 1,197 are already traversed in advance, and the balance of 228 square miles is the area already mentioned as remaining for traverse survey. In the outturn of 1892-93, however, 12 square miles of traverse survey were in the Gandak *diara* to the south of the district and have not yet been cadastrally surveyed, and will therefore have to be re-traversed, which raises the traverse programme in Saran district to 240 square miles.

Survey of the Champaran District.

273. *Traverse survey.*—The area traversed in this district consists only of the *diara* lands of the River Gandak, which it was inadvisable to survey in previous seasons, as, owing to the action of the river, all theodolite station marks would have been washed away in the interval between traverse and cadastral survey. The following table gives the particulars of the traversing:—

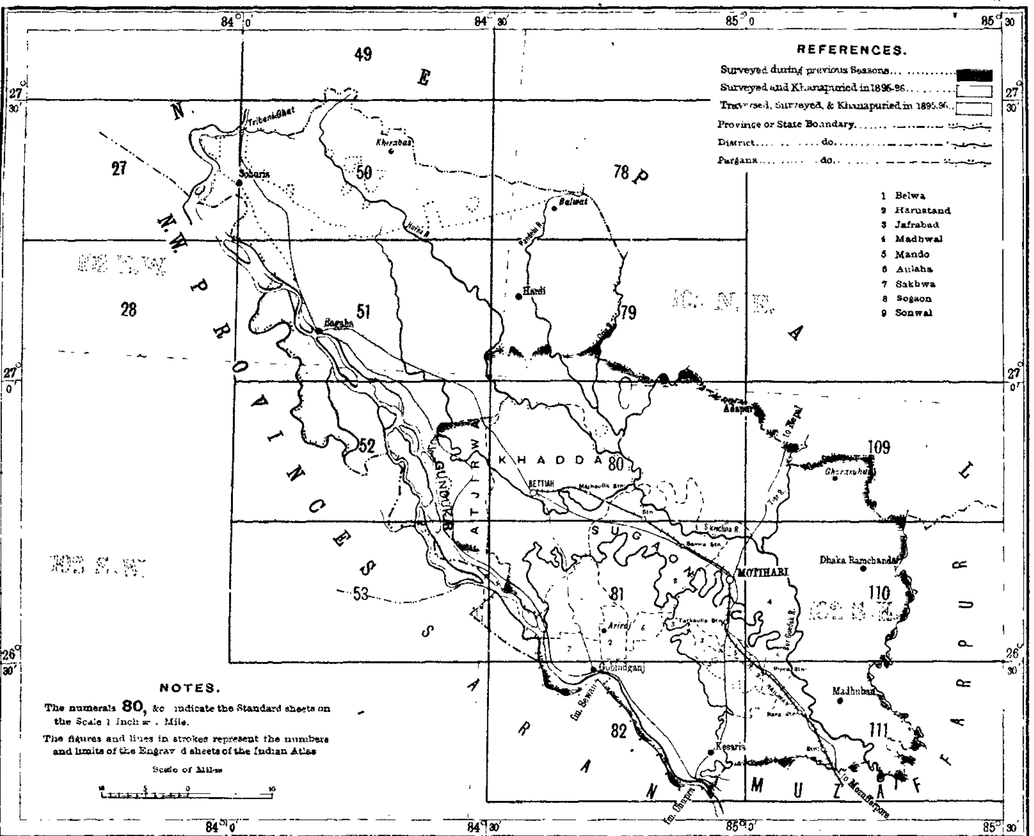
District.	Number of village circuits.	Number of stations.	Area in square miles.
Champaran	154	5,872	385·92

The total number of linear miles of new chaining was 1,195. Fourteen observations for azimuth were taken. Of the station marks, only 300 were on high ground not subject to yearly inundation. Of these, 16 were marked with stones, and the remainder with clay cylinders. The stations in low-lying ground were all marked with wooden pegs. As the plots of the season's traverse were

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTRICT CHAMPARAN.

1895-96. Nos. 4 & 5 PARTIES.



Reg No. 484, S. I. D.—Jan 97—1 050.

Photo., S. I. O., Calcutta.

No. 312-S. 97.

urgently required for cadastral survey during the same season it was necessary to commence traverse operations early, and the section accordingly took the field on 25th October, 1895, having sent its line-cutters ahead some time previously. All the computations in connection with the season's work were completed, as well as some small arrears of previous seasons, and only the final examination of the records remains to be done. The cost-rate of the traverse survey was R24 per square mile.

274. *Cadastral survey and record-writing.*—Two cadastral sections were employed in this district during the season, under Messrs. R. B. Smart and A. W. Smart, respectively, and they commenced field-work on the 1st November, 1895, and returned to recess quarters at Dinapur on the 29th April, 1896. The particulars of the cadastral survey are given in the following statement :—

District.	Cadastral survey, 16 inches = 1 mile and record-writing.		
	Number of villages.	Number of fields.	Area in square miles.
Champaran	1,047	602,166	1,184·7

This area is mapped on 2,008 sheets. The average size of the field was 1·30 acres.

275. The cadastral survey was checked by 2,361 linear miles of *partal* by European officers and "independently," and by 2,779 linear miles by inspectors, which gives an average of 4·34 linear miles per square mile of survey. The number of entries checked in all the field records by European officers was 7,590, and by inspectors 155,326, or an average of 27 per cent. of the whole number of plots.

276. Traces and records of the entire season's work were completed and sent to the Settlement Officer. The greatest difficulty met with during the season was the extreme unhealthiness of the tract under survey. Half the establishment was at times prostrated by malarial fever and there were several deaths. The cost-rates are, for cadastral survey, etc., Rs. 56·5, and for record-writing, etc., R47·4, per square mile.

277. With the exception of an approximate area of 290 square miles in the north of the district, which is not to be surveyed, the survey of the Champaran district has been completed. The following statement shows the areas accomplished year by year in traverse, cadastral survey and record-writing :—

Year.	Areas in square miles.		
	Traverse survey.	Cadastral survey.	Record-writing.
1891-92	363	...	...
1892-93	1,103	416	320
1893-94	1,320	517	599
1894-95	126	1,162	1,176
1895-96	386	1,185	1,185
	3,298	3,280	3,280

Survey of Bettiah Town.

278. The Christian Tola belonging to the Roman Catholic Mission in Bettiah town, covering an area of ten acres only, was surveyed on the 64-inch scale during the season. A record of occupancy has been prepared and contains entries for 2,248 holdings. Five extra sub-traverses were necessary to ensure the accuracy of the work. The cost was R160, which is debitable to the proprietor.

SURVEY OF THE MUZAFFARPUR DISTRICT.

279. *Traverse survey.*—The only traverse operations undertaken in this district were with reference to the re-survey of four Government estates in the Hajipur *diara*, which had been originally surveyed in 1893-94, but which, on account of the many changes, owing to extension of cultivation and river action, had to be re-surveyed. In connection with the above work, the traverse survey of 7·38 square miles in the two estates of Sukhwarpur and Jurawanpur Taufir was undertaken. The number of linear miles of new chaining was 28, and 99 observations were taken with the theodolite. In addition to the above, an area of 12 square miles was traversed in *mauza* Sabalpur, which was at one time in the Patna district, but of which a portion, owing to changes in the course of the Ganges, now falls in Muzaffarpur. In this village 211 observations were made with the theodolite and the linear chaining amounted to 31 miles.

280. *Cadastral survey and record-writing.*—The operations of the Muzaffarpur cadastral section, under Mr. C. S. Kraal, were confined to the northern portion of the Sitamarhi subdivision. The following statement gives the particulars of the cadastral survey and record-writing :—

DISTRICT.	CADASTRAL SURVEY, 16 INCHES=1 MILE, AND RECORD-WRITING.		
	Number of villages.	Number of fields.	Area in square miles.
Muzaffarpur	427	567,008	431·22

This area is mapped on 639 sheets. The average size of the field is 0·49 of an acre.

281. The cadastral survey was checked by 59 linear miles run by European assistants, by 1,026 linear miles by inspectors, and 550 linear miles "independently," giving an incidence of 3·8 linear miles of test lines to each square mile of survey. Of the entries in the records, 8,016 were tested by European officers and 177,543 by inspectors, giving a percentage of 32·7 of the total number of entries.

282. The records of the entire season's work were completed and made over to the Settlement officer. The cost-rates of the work are, for cadastral survey, etc., R85·2, and for record-writing, etc., R87, per square mile.

283. In 1892-93 a special cadastral survey was made of 10 villages in the Muzaffarpur district belonging to the Darbhanga Raj, with a view to a comparison being made with the survey of the same villages made by Mr. Finucane in 1878-79. As nine of these villages fell within the season's operations it was decided to merely bring the maps and records prepared in 1892-93 up to date. The actual area comprised in these villages is 6·95 square miles, containing 10,600 fields. In 1892-93 these villages contained only 10,023 fields. They have been mapped on 9 sheets on the 16-inch scale. As the survey of 1892-93 was fully tested, no check lines were run, but the usual precaution of testing changes on the maps while the record-writing was being inspected was taken. The cost-rates of this work were, for cadastral survey, etc., R53·1 and for record-writing, etc., R19·3, per square mile.

284. The survey of three villages made by Mr. Finucane in 1878-79 was also revised during the season. The amount of work accomplished in both revision of maps and records was 12,522 fields, covering an area of 6·84 square miles. Both maps and records were fully tested. The cost-rates are, for the revision of maps, R72, and for the revision of records, R84·9, per square mile.

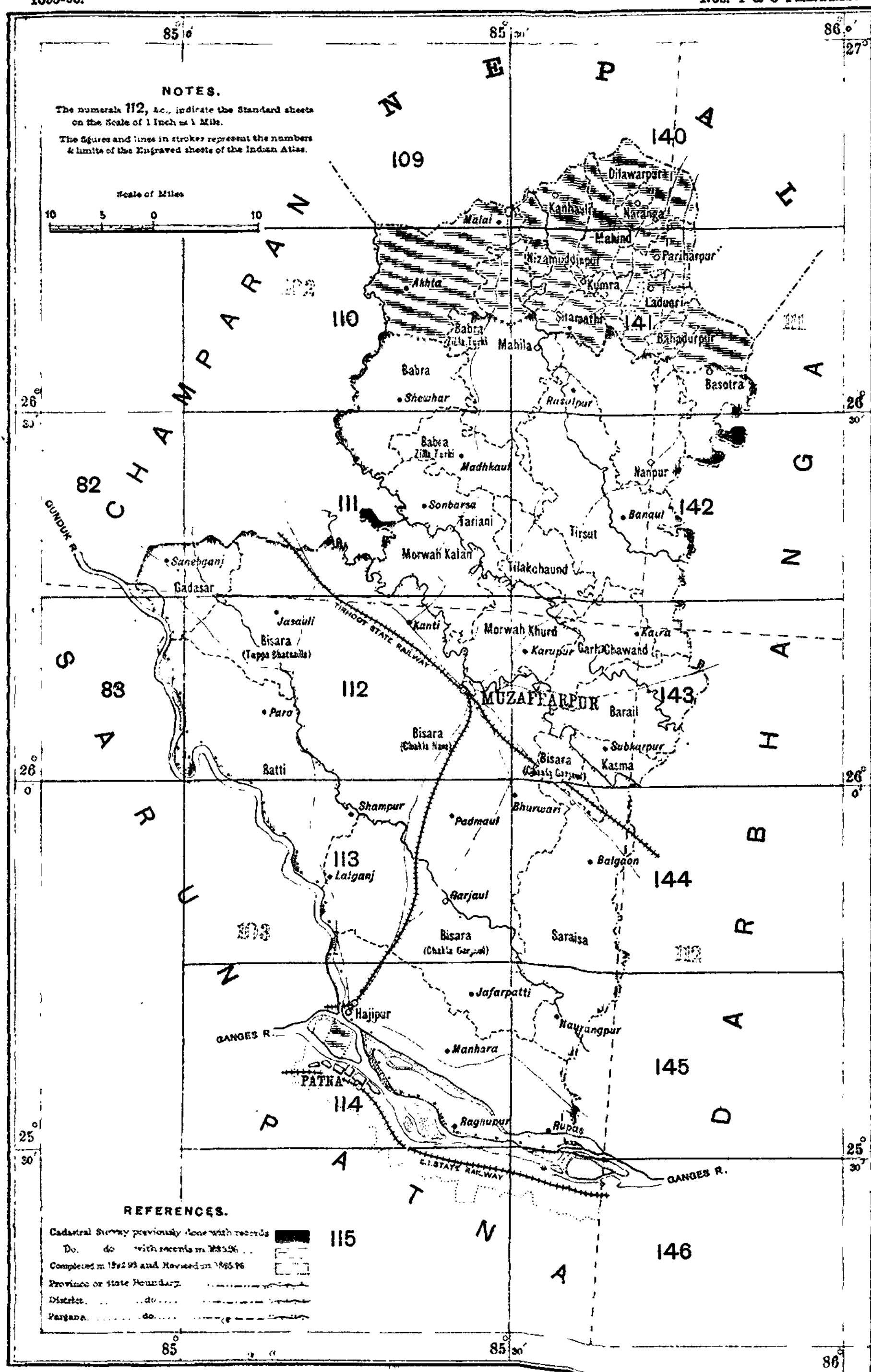
285. A further area of cadastral survey was undertaken in the Hajipur *diara* at the request of the Settlement Officer on account of the extensive changes which had taken place since 1893-94, the season in which this tract had been previously surveyed. The area, which lay in four estates, amounted to 8·52 square miles, containing 3,571 fields. They were mapped on 14 sheets. The cost will be defrayed by the Collector.

286. A cadastral survey was also made of the Sabalpur estate, which, as already mentioned, lay formerly in the Patna district, but now lies partly

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTRICT MUZAFFARPUR.

1895-96. Nos. 4 & 5 PARTIES.



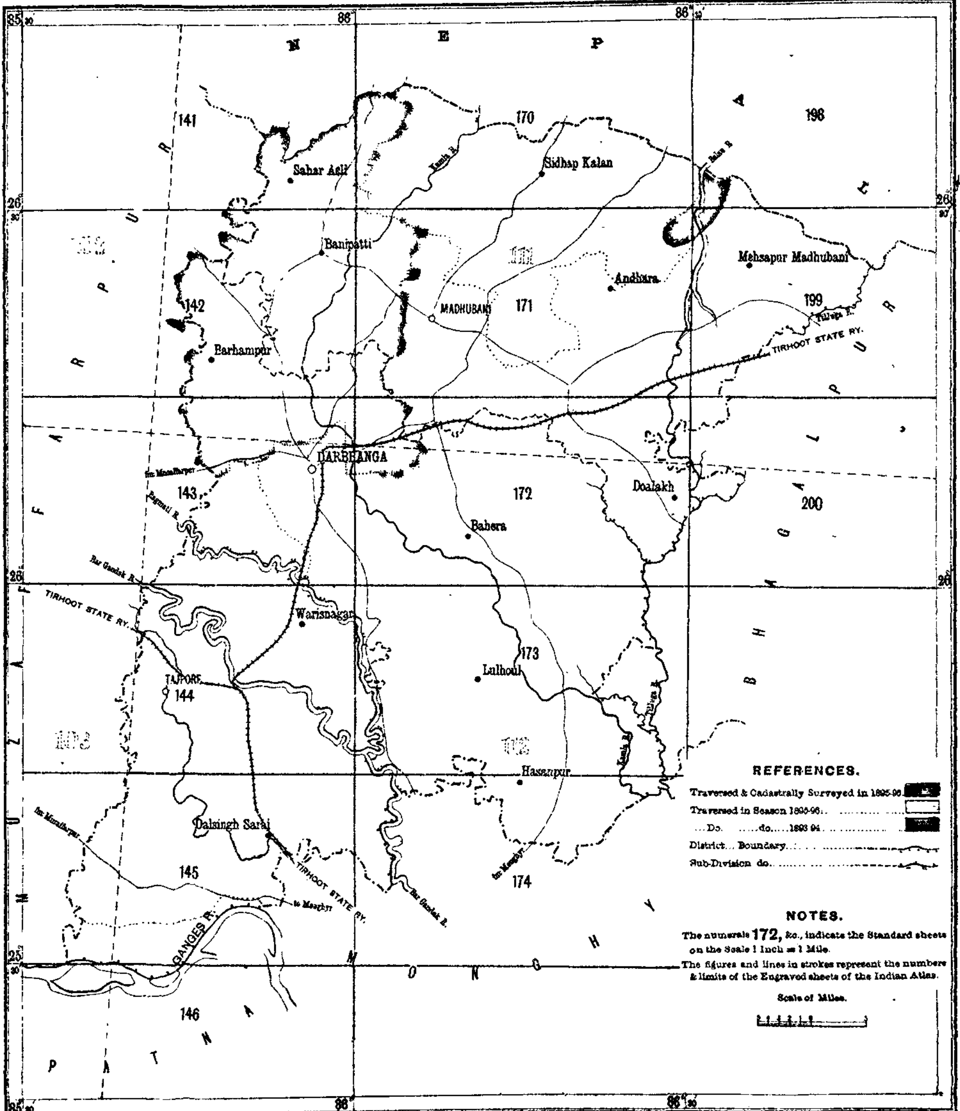
Ref. No. 607, S. I. D.—Jan. 97—1,000 Photo., S. I. O., Calcutta.

No. 309-S. 97.

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTRICT DARBHANGA

1895-96. Nos. 4 & 5 PARTIES.



Reg. No. 487, S. I. D.—Dec. 96—1,000

Photo. S. I. O., Calcutta.

No. 459-S. 96.

in Muzaffarpur owing to changes in the river. The area amounts to 12·12 square miles, containing 1,963 fields, and it has been mapped on 25 sheets. The cost of this survey has been met from the grant for the season's operations in district Saran.

287. The preparation of a map on the 16-inch scale of the Lalganj Municipality was undertaken at the request of the Settlement Officer. The entire area was originally included in the operations of 1893-94, and the extent of work performed during the season under report included the demarcation of the exterior boundaries of the municipal limits, the demarcation of the actual town area, and the compilation of a wall map on the 16-inch scale. The area was 3·67 square miles and comprises eleven entire villages and a portion of one village. The cost of the work is recoverable from the Municipality.

288. The Sitamarhi Municipality is contained within seven villages and portions thereof. The entire area is approximately 3,200 acres, of which the actual town portion, 192 acres, has been surveyed on the 32-inch scale during the season under report. The remainder of the municipal area was surveyed on the 16-inch scale partly during last and partly in this season. A record of occupancy has been prepared, and a wall map on the 16-inch scale is under compilation. The cost will be recovered from the Municipality.

289. The survey operations have now been completed in the Muzaffarpur district.

SURVEY OF THE DARBHANGA DISTRICT.

290. *Traverse survey.*—The traverse operations in this district were in continuation of those in season 1893-94. The particulars are given in the following statement:—

DISTRICT.	Number of village circuits.	Number of stations.	Area in square miles.
Darbhanga	1,314	21,870	1,179

The total linear miles of new chaining was 4,298 and the number of azimuth observations 11. Of the 21,870 new stations, 21,576 have been permanently marked, *viz.*, 2,380 tri-junction points with stone prisms and the remainder by clay cylinders or bamboo pegs, the latter being used on disputed boundaries, to be permanently marked on settlement of the disputes. The cost-rates are, for demarcation R3·7 and for traversing R19·5 per square mile.

291. *Cadastral survey and record-writing.*—The only cadastral survey undertaken in this district was that of a few villages in the Jabdi *pargana*, *taluka* Lahiri. Owing to the late receipt of plots, the survey could not be commenced till the 21st February 1896, and field work was completed during the first week in May. The following statement gives the particulars of the cadastral survey and record-writing:—

DISTRICT.	CADASTRAL SURVEY, 16 INCHES=1 MILE, AND RECORD-WRITING.		
	Number of villages.	Number of fields.	Area in square miles.
Darbhanga	14	15,298	16·23

This area is mapped on 23 sheets. The average size of the field is 0·68 of an acre.

292. The survey was checked by 41 linear miles run by European officers and "independently" and 29 linear miles by inspectors, giving an incidence of 4·36 linear miles of test lines to each square mile of survey. The accuracy of the records was tested by checking 28 per cent. of the entries in the whole number of plots.

293. All the traces and records were completed and made over to the Settlement Department. The cost-rates are, for cadastral survey, etc., R51, and for record-writing, etc., R52·3, per square mile.

294. The total area traversed up to date in this district amounts to 1,697 square miles. The area of the district is returned by the old revenue survey as 3,233 square miles, which would leave 1,536 square miles still to be traversed. But of this about 640 were surveyed by Mr. Finucane in 1878-79, which are, under existing orders, only for revision survey, and therefore require no traversing, but it is understood that the Darbhanga Raj have lately asked that about 320 square miles of their villages may be surveyed entirely anew, which would leave the future traverse programme as 1,216 square miles. Of the 3,217 square miles remaining for cadastral survey and record-writing, probably 2,897 square miles will be entirely new survey and record-writing, and the balance of 320 square miles a revision of the maps and records of 1878-79.

SURVEY OF THE GAYA DISTRICT.

295. The traverse and cadastral survey, with record of rights, of the Government estates in this district were continued.

296. *Traverse survey.*—A small section, under Mr. G. T. Hall, undertook the traverse survey, of which the following statement gives the particulars :—

DISTRICT.	Number of village circuits.	Number of stations.	Area in square miles.
Gaya	11	305	15

Field work was commenced on the 1st November, and on completion of the traverse survey the surveyors were moved into the Monghyr district for the survey of the Narhan Ward's estate. The demarcation, which should have been completed beforehand, was found extremely defective, and this interfered with the rate of progress to a considerable extent. The angular work was checked by five azimuth observations. The linear miles of new chaining amounted to 51. The cost-rate per square mile was R56.

297. *Cadastral survey and record-writing.*—The following statement gives the particulars of the cadastral survey :—

DISTRICT.	CADASTRAL SURVEY, 16 INCHES=1 MILE, AND RECORD-WRITING.		
	Number of villages.	Number of fields.	Area in square miles.
Gaya	11	6,935	15

This area is mapped on 22 sheets. The average size of the field, excluding one village which is mostly jungle, is 0·47 of an acre.

298. The survey was checked by 28 linear miles of test survey, giving an incidence of 1·85 linear miles to each square mile. The record-writing was checked by testing the entries against 1,460 fields in the field, or an average of 21 per cent.

299. All the records were completed in every respect and sent to the Settlement Department. The cost-rates are, for cadastral survey, etc., R39·7, and for record-writing, etc., R36·3 per square mile.

300. The traverse and cadastral survey of the Belkhara Estate, in the Gaya and Patna districts, was undertaken by the detachment engaged on the above work. An area of 8·5 square miles, comprising 13 villages, was traversed, the number of linear miles of new chaining being 60. The cost-rate of the traverse survey was R110·2 per square mile.

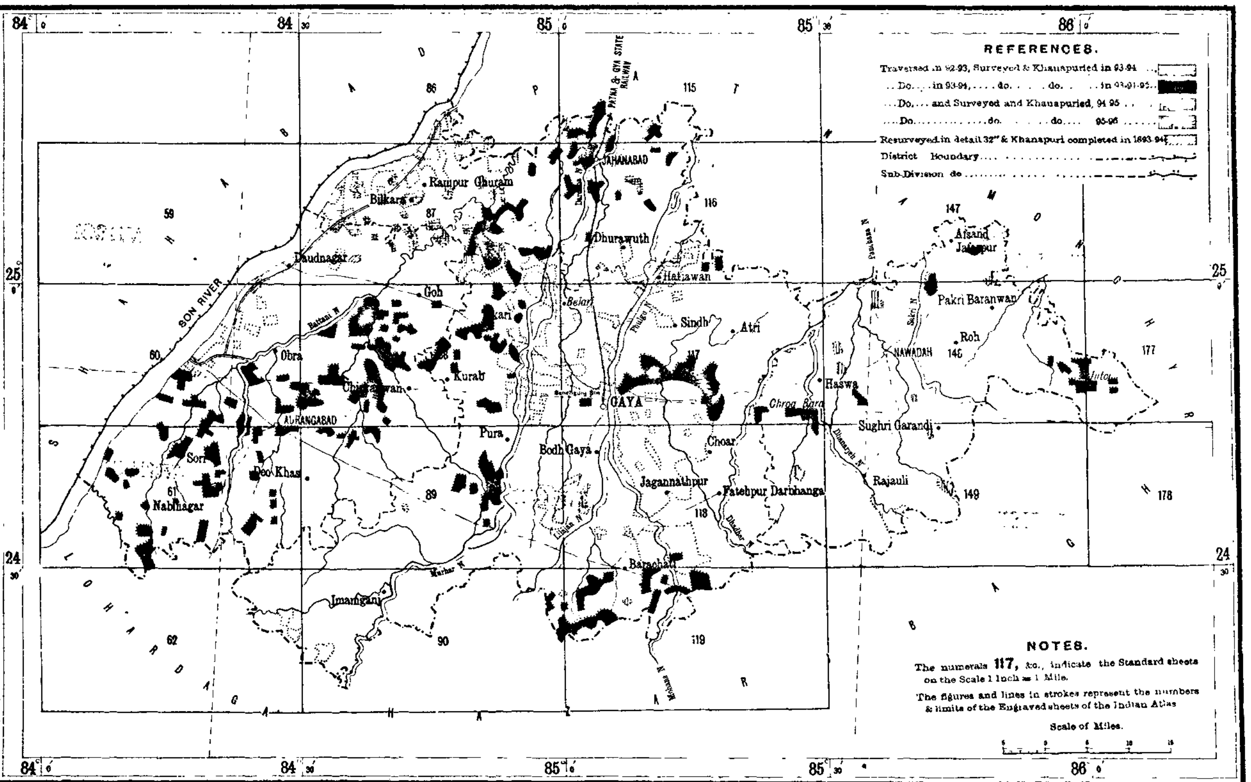
301. A considerable portion of this estate had been already surveyed in 1875-76 on the 32-inch scale, in the course of the Sone Canal irrigation survey

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN THE TIKARI & GOVT. ESTATES IN DIST. GAYA.

1895-96.

Nos. 4 & 5 PARTIES.



Reg. No. 506, S. I. D.—Jan. 97.—1,050.

No. 311-S. 97.

BENGAL SURVEY.

1895-96. INDEX TO THE CADASTRAL SURVEY OF THE TIKARI ESTATE IN DIST. PATNA — Nos. 4 & 5 PARTIES.

REFERENCES.

Surveyed and Khanapuried during 1894-95
...Do.... Boundary only .... do.
Traversed during Season 1895-96
District Boundary
Sub-Division Boundary

NOTES.

The numerals 115, &c. indicate the Standard sheets on the Scale 1 Inch = 1 Mile.
The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas.

Scale of Miles.



Reg. No. 458, S. I. [illegible] 96 —1,050.

Photo. S. I. O., Calcutta.

No. 458-S. 96.

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTRICT MONGHYR.

1895-96. Nos. 4 & 5 PARTIES.

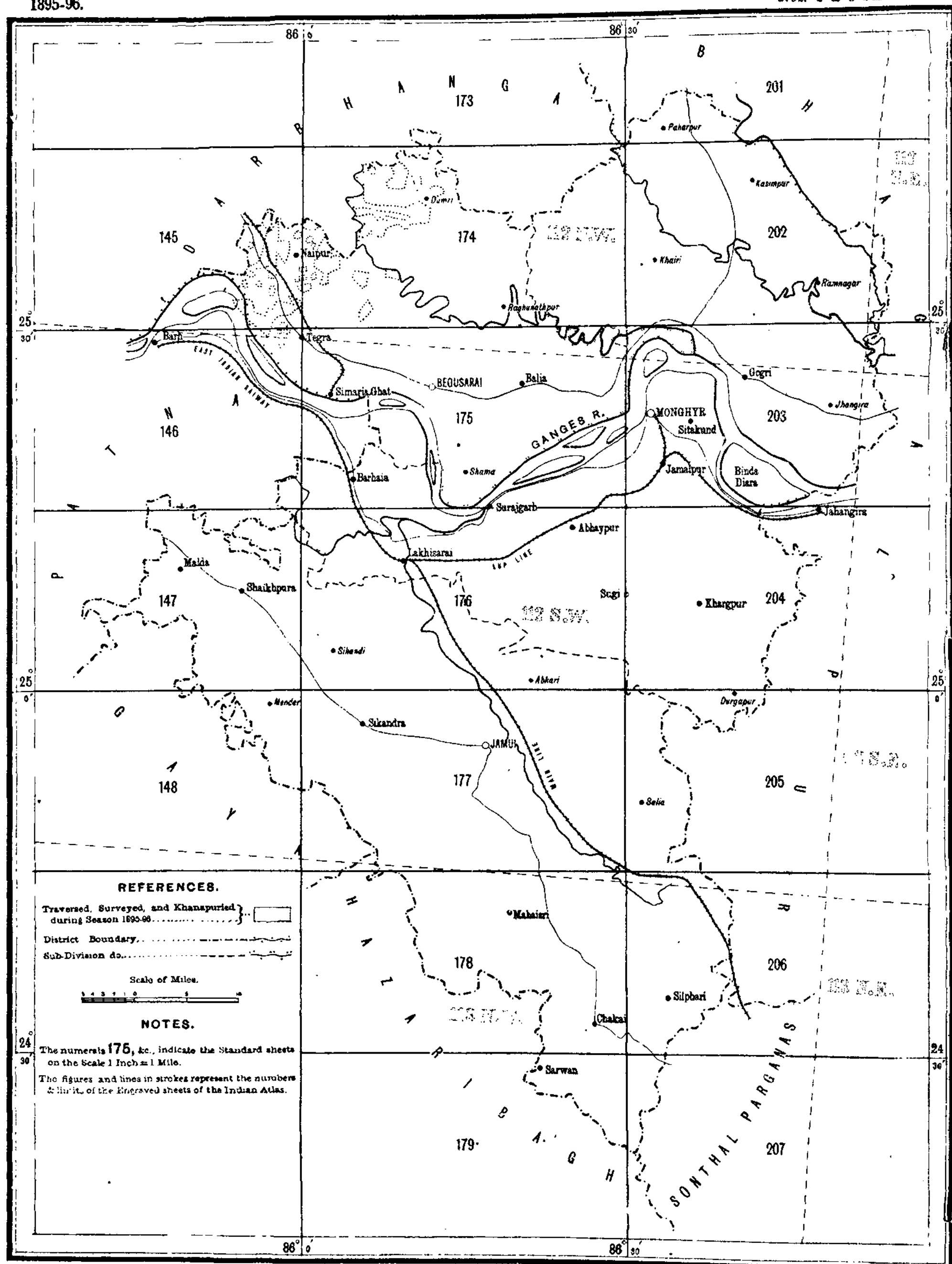


Photo., S. I. O., Calcutta

No. 310-S. 97.

and these maps were revised during the year under report. The following statement gives the particulars of the new cadastral survey executed :—

District.	Cadastral Survey, 16 inches=1 mile.			Record-writing.		
	Number of villages.	Number of fields.	Area in square miles.	Number of villages.	Number of fields.	Area in square miles.
Gaya . .	17	14,416	14·18	19	17,326	16·78

The revision survey on the 32-inch scale was as follows :—

District.	Revision Survey, 32 inches=1 mile.			Record-writing.		
	Number of villages.	Number of fields.	Area in square miles.	Number of villages.	Number of fields.	Area in square miles.
Gaya . .	35	43,965	31·5	58	84,709	62·0

The excess of record-writing over survey in both the above statements is due to the completion of arrears of the previous season. The mapping on the 16-inch scale was contained in 23 sheets, and on the 32-inch scale in 126 sheets. The average size of the field was 0·47 of an acre in the irrigation area and 0·62 in the remainder of the villages under survey.

302. The detail survey on the 16-inch scale was checked by 115 linear miles test survey by European officers and " independently," and by 210 linear miles by inspectors, or an average of 22 linear miles per square mile. The record-writing was checked by the testing of 1,189 entries in the field records by European officers, and 25,690 entries by inspectors, or an average of 26 per cent. of the whole.

303. The cost-rates of the work were as follows :—For new survey on the 16-inch scale, including mapping, etc., R194·6, and for record-writing, etc., R91·9, per square mile. For the revision of the 32-inch work, R83·9, and for the record-writing, etc., in connection therewith, R75·8, per square mile.

304. The survey and record-writing of the Tikari Ward's estates have now been completed.

Survey of the Narhan Ward's Estate.

305. The survey of this estate in district Monghyr was ordered by notification No. 814 T.R., dated 30th October 1895. Only villages in which the estate owned a half share or more were to be surveyed, and it was understood that 68 villages, covering an approximate area of 34 square miles, fulfilled this condition.

306. *Traverse survey.*—Field work commenced on the 31st December 1895 and closed on the 26th May 1896. The following statement gives the outturn of traverse survey :—

District.	Number of village circuits.	Number of stations.	Area in square miles.
Monghyr	62	1,842	58

These villages are not in one block but are scattered over three *parganas*. The linear miles of new chaining amounted to 352, and 25 observations for azimuth were taken.

307. Of the 1,842 new traverse stations, 302, being tri-junction points, were marked by stone prisms, and the remainder by baked clay cylinders, except on disputed boundaries, where the stations were temporarily marked by pegs.

308. The cost-rate of the traverse survey was R40 per square mile.

309. *Cadastral survey and record-writing.*—The following statement gives the outturn of cadastral survey:—

District.	Cadastral Survey, 16 inches=1 mile.			Record-writing.		
	Number of villages.	Number of fields.	Area in square miles.	Number of villages.	Number of fields.	Area in square miles.
Monghyr	66	69,436	53·75	60	60,420	46·77

From a comparison of the above statement with that for traverse survey it appears that two villages (11 square miles) were unnecessarily traversed, and that 6 villages (7 square miles) were unnecessarily surveyed in detail. It is impossible to reconcile the number of villages in the figures for traverse survey, cadastral survey and record-writing, because villages as traversed were afterwards amalgamated and split up to conform with the revenue survey *mauzas.* The excess of detail survey over record-writing is due to the fact that in six villages it was not discovered until after the completion of the cadastral survey that the estate share was less than one-half.

310. The mapping is contained on 93 sheets.

311. The cadastral survey was checked by 115 linear miles of test lines by Mr. Hall and "independently" and 207 linear miles by inspectors, or an average of 5·9 linear miles per square mile. The entries against 536 plots were checked by Mr. Hall in the field records, and 15,366 by inspectors, or a percentage of 26·3 of the whole number.

312. The cost-rates of the work are, for cadastral survey, etc., R156·4, and for record-writing, etc., R114·8 per square mile.

Survey of disputed boundaries in Bhagalpur District.

313. The survey of the boundaries of *mauza* Tintanga touching on *mauza* Buddhu Chak was undertaken at the instance of the Collector of Bhagalpur. The work was completed early in April. The total area traversed, without offsets, was 42·5 square miles; the linear miles of chaining amounted to 48·5, of which only 8 miles was along the boundaries in dispute. The Collector was supplied with a complete plot of Tintanga on the 4-inch scale, and also with plots on the 16-inch scale of the disputed portion, showing all details of the boundaries as now laid down. Copies of the traverse tables and field books have also been made over to the Collector.

314. In Champaran, both the traverse and cadastral sections suffered severely from malarial fever. In one section there were 27 deaths, in another 12, and in the third 8. A large portion of the establishment absconded from fear of being attacked by fever, and but for the energy and tact displayed by the Messrs. Smart the work must have come to a standstill. During the recess season there were 7 deaths from cholera in these sections.

In Muzaffarpur and Saran the health of the establishments was fairly good. There were a few cases of cholera.

In Monghyr and Gaya there were a few cases of fever, small-pox and cholera, but on the whole the health of this section was good.

In Darbhanga the traverse section suffered a good deal from fever, but not enough to seriously interfere with work.

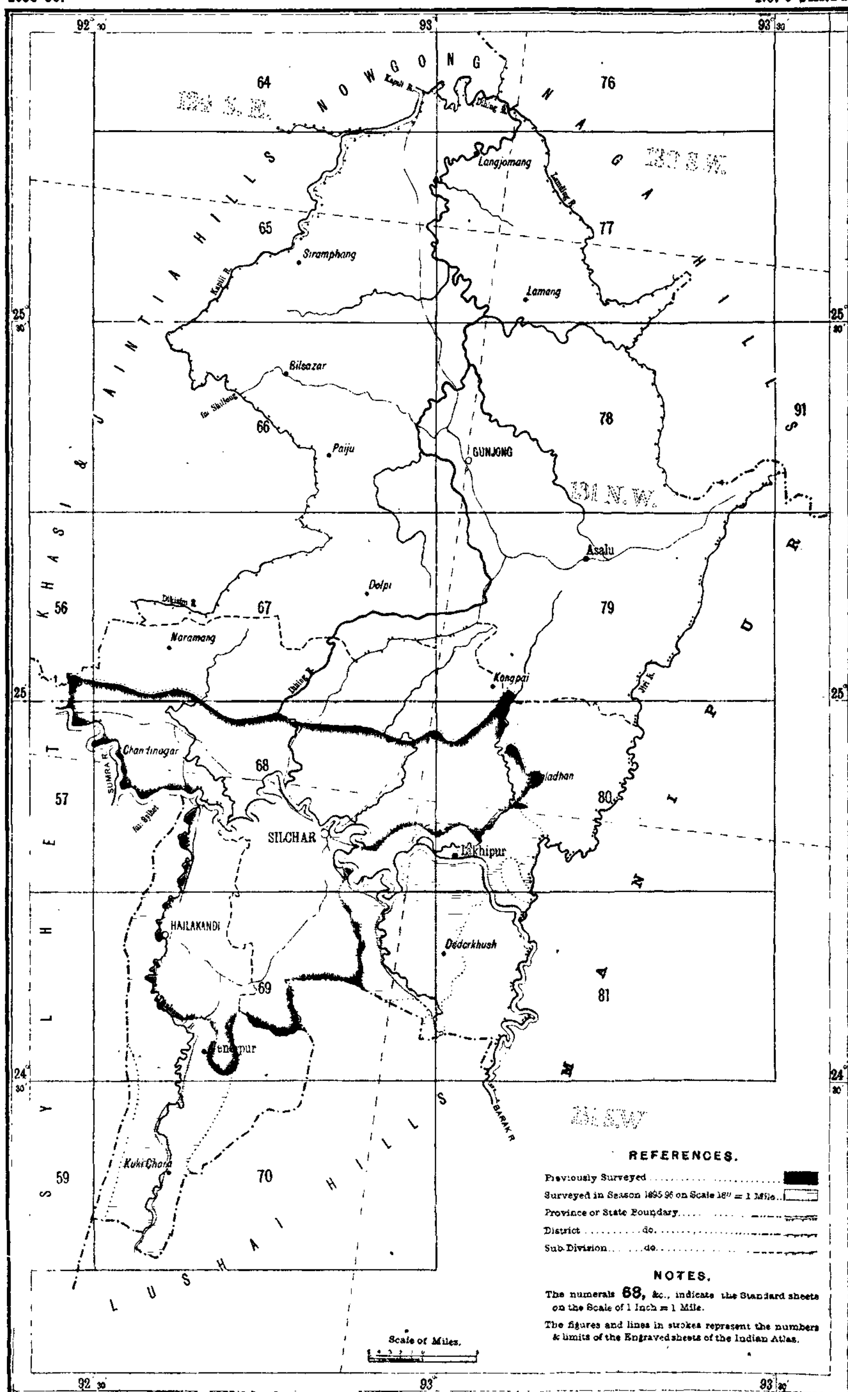
315. During the year under report four members of the Civil Service were attached to survey sections for a short course of instruction in cadastral surveying and record-writing. They all surveyed a small area cadastrally and wrote up the record of the same.

316. In all the districts in which survey operations have been in progress the relations between the officers of the Survey and Settlement Departments have been most cordial.

317. The Deputy Surveyor General, Revenue Branch, inspected the Muzaffarpur and Saran cadastral sections early in 1896, while still in the field, and the traverse camp of the party during recess. He found the work

ASSAM SURVEY.

1895-96. **INDEX TO THE CADASTRAL SURVEY IN DIST. CACHAR.** No. 6 PARTY.



Reg. No. 401, S. I. D.—Jan. '97.—350

Photo. S. I. O., Calcutta.

No. 319-S. 97.

being systematically conducted in all branches under Captain Crichton's supervision. The many radical changes in the procedure of the cadastral camps which were introduced by the Deputy Surveyor-General, in the anticipation that, among other good results, they would put an end to arrears, have now been given full play and have had the desired effect.*

ASSAM.

No. 6 PARTY.

318. This party, under the temporary charge of Mr. W. H. Penrose, left Shillong on the 16th October for Silchar, where field office was opened on the 26th October. Mr. Penrose was relieved by Mr. Barrett on his return from furlough on the 2nd November.

Personnel.

Mr. E. C. Barrett, Superintendent, 2nd grade, in charge from 2nd November 1895.
" W. H. Penrose, Extra Assistant Superintendent, 5th grade, in charge up to 2nd November 1895.
" F. S. Bell, Sub-Assistant Superintendent, 1st grade.
14 sub-surveyors, computers, draftsmen and others.

Temporary Establishment.

32 supervisors, draftsmen, computers, etc.
22 inspectors.
14 field surveyors (Hindustanis).
13 ditto (Bengalis).
103 ditto (local).

319. The programme comprised the traverse and cadastral survey of 163·8 and 349·2 square miles, respectively, completing the survey of the Cachar district.

320. The outturn of traverse survey, which was situated to a great extent in the jungle-covered hills to the south-west and east of the district, is shown in the following table:—

DISTRICT.	Number of villages.	Number of sub-traverses.	Number of traverse stations.	Area in square miles.
Cachar	175	82	7,484	163·89

321. A survey class, under Messrs. Penrose and Bell, was opened at Silchar on the 1st November, for the instruction in field-to-field surveying of officers of the administration and local men. The following passed:—

Mr. F. E. Jackson, Mr. H. A. C. Colquhoun, 1 Extra Assistant Commissioner, 3 probationary Sub-Deputy Collectors, 1 tahsildar, 3 Government district surveyors, 1 *kanungo*, 15 *moharrirs*, 32 Jaintia *patwáris* and 153 ordinary local men. Eighty-three local men failed to pass.

322. The intersection of latitude 24° 45′ with longitude 92° 43′ was again assumed as the origin of survey. The theodolite was set up at 7,484 stations and the aggregate length of the traverse lines was 529 linear miles. The angular work was checked by 66 azimuths. The corrections along main circuits was 1′ in 10½ angles and along the villages 1′ in 7 angles.

323. Of the total number of triple-junction points within the season's work, 124 old prisms or stones were utilized, 227 new prisms 3 feet × 1 foot × 1 foot were put up, and 83 have yet to be put up, making a total of 434. "Intermediate" stations—that is, stations situate between triple-junctions—have either been or are to be marked by stones 3 feet × 3 feet × 4 inches. The position of all station points not already marked by stones are indicated by branches of quick-growing trees planted 5 feet to the magnetic north of stations.

324. The area cadastrally surveyed lies in portions of each subdivision of the district south of the North Cachar Hills. The number of grants and

* Captain Crichton reports that Lieutenant Symonds, who supervised the operations of one traverse and five cadastral sections, deserves credit for the manner in which he carried on his duties.
Messrs. H. T. Hanby, R. B. Smart, J. McHatton, G. T. Hall, A. W. Smart, and C. S. Kraal, in charge of sections, have all worked indefatigably and well. The Messrs. Smart deserve special mention for the manner in which they continued work when more than half their establishment were prostrated with fever. The junior assistants, Messrs. E. F. Berkely, C. G. Lee, C. S. Gasper, H. H. B. Hanby, P. K. Vaughan, Babu Nilmony Chatterjee, and Messrs. Pyster, McIntyre, and Taylor, have all done excellent work.

other estates, all of which were surveyed on the scale of 16 inches to the mile, comprised 28 grants, 738 *jungleburi mahals*, 4 *bakshas*, and 55 holdings under special tenures. The grants were all surveyed by Hindustani *amins* and sub-surveyors. The field-to-field work was exclusively surveyed by local *amins* working under Hindustani inspectors. The outturn of cadastral survey is given in the following table:—

DISTRICT.	Tahsil or pargana.	Number of villages.	Number of fields.	Area in square miles.
Cachar	Sadar	227	100,912	203·6
	Hailakandi	132	54,006	145·6
	TOTALS .	359	154,918	349·2

325. In the *rayatwari* lands, the boundaries of which were fixed by the Revenue Survey in 1883-84, the agreement was excellent, but in the case of those grants which were mapped by private surveyors and which were ordinarily very roughly drawn, there was generally no agreement whatever. The boundaries have in consequence been passed provisionally in blue, as surveyed, pending a decision being arrived at with regard to them during the ensuing season by the Survey and Settlement Departments.

326. The 16-inch survey was checked by 1,242·9 linear miles of *partal*, of which 223·8 linear miles were run by Europeans, 420·5 linear miles (independently) by *amins*, and 598·6 by Hindustani inspectors. The check survey averaged about 3·6 linear miles to the square mile. Of this total the *partal* run by European and independent agencies taken together averaged 1·8 linear miles. The quality of the work was found to be very good. The *dag chitta* entries of 2,515 fields were examined on the ground by European officers and 17,009 fields by inspectors.

327. The revision survey of the 540·5 square miles of cadastral survey completed in 1894-95 was commenced on the 1st December 1895 and brought to a close on the 21st June 1896. Thirty-eight *amins*, each accompanied by a settlement *munsarim*, were employed in the work. The *amin* was given the village trace and the *munsarim* the " points for enquiry " and the two together completed the work most satisfactorily.

328. The season's outturn has been mapped on 444 sheets and the Settlement Officer has been provided with two tracings of each sheet.

329. The cost-rate of survey operations, including traversing, detail survey, statistics, and completion of records, was R217·4 per square mile. The rate is, as was expected, much higher than that of 1894-95, owing to the area surveyed having been less than that of the previous year by nearly 200 square miles.

330. The average daily outturn of field survey in acres, mapped by the different agencies employed, is given below :—

	Acres.
By Hindustani *amins*	56·30
„ Bengali „	18·48
„ Survey class pupils	12·71
„ local *amins*	8·24

331. The elephant "Gaganmala" is old and weak and was of very little use during the field season. On the 8th of June the elephant "Stormer" broke away from his *charcutter*, whom he wounded badly, and killed a villager who happened to come in his way. He was recaptured in August badly wounded and is not likely to be of use for several months.

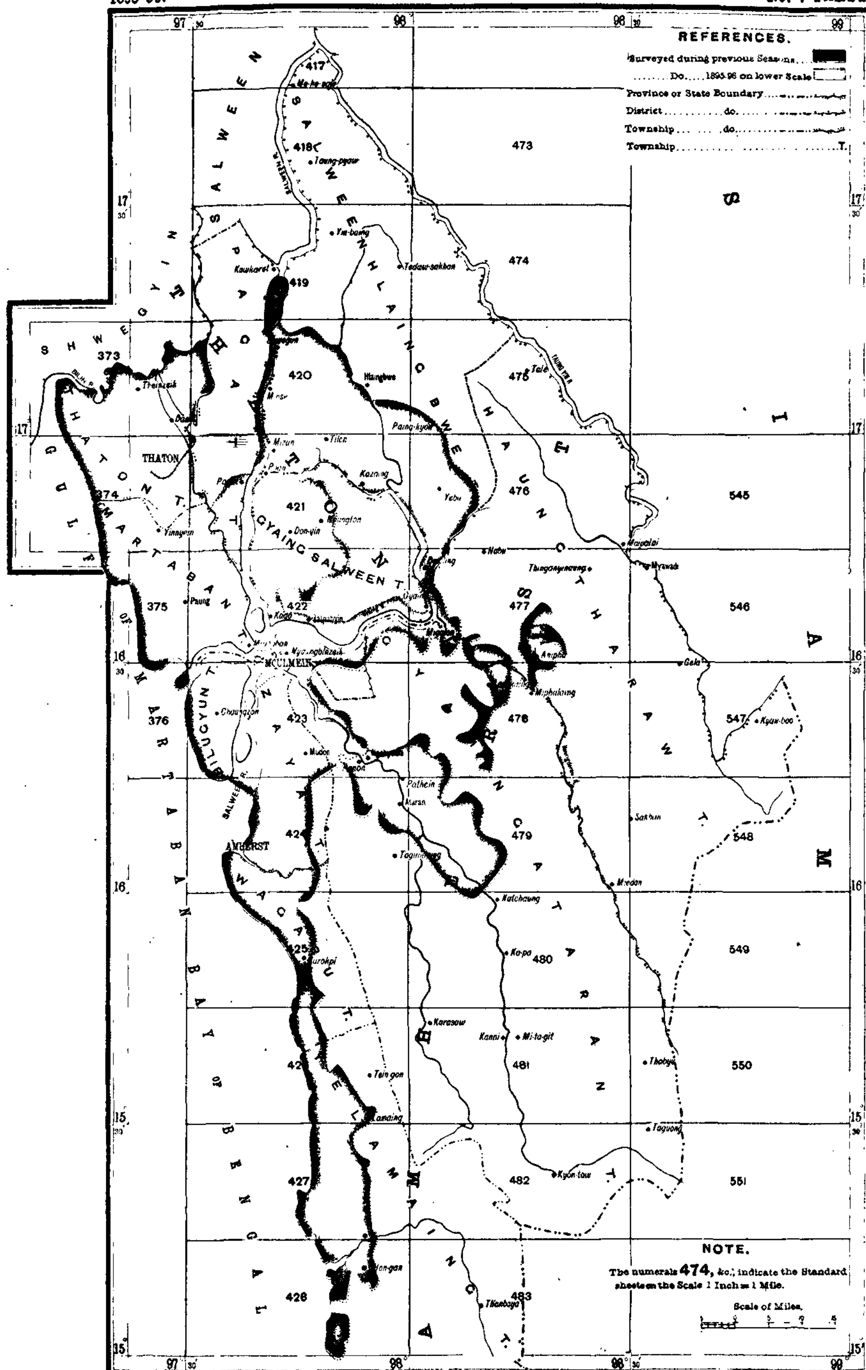
332. The attitude of the people was all that could be desired; there was not a single case of friction between the survey and either the planting community or the *rayats* of the district.

333. The programme for 1896-97 is under consideration; it was intended to have either abolished this party or to have transferred it elsewhere. It has,

BURMA SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTS. AMHERST & THATON.

1895-96. No. 7 PARTY.



Reg. No. 456, S. I. D.—Jan. 97.—650. Photo., S. I. O., Calcutta

No. 322-S. 97.

however, been represented that there is still much important work left for the party in the province, consisting of (*a*) the traversing of certain temporarily settled estates in Sylhet, of the extension surveys made by the settlement officers and of outlying tea grants, (*b*) the topographical survey of gaps between the cadastrally surveyed areas, and (*c*) the revision of the cadastral survey of the year under report. If this is sanctioned it will occupy the party another two years.

334. The recess office of the party was inspected by the Deputy Surveyor General at Shillong. He found Mr. Barrett engaged in completing the last season's cadastral survey of Assam, on which he has been engaged for thirteen years. The work is doubtless of first-class quality, and is executed almost entirely through local agency, with a view to educate it for usefulness in the future, which is creditable to Mr. Barrett. The standard sheets of this party are also excellent specimens of draftsmanship.*

THATON AND PEGU DISTRICTS, LOWER BURMA.

No. 7 Party.

335. During the year under report the charge of this party was held by Mr. B. G. Gilbert-Cooper, the late Mr. C. Wood having relinquished charge on the 11th December 1895 owing to failing health.

Personnel.

Mr. C. Wood, Deputy Superintendent, 2nd grade, in charge up to 11th December 1895.
„ B. G. Gilbert-Cooper, Deputy Superintendent, 2nd grade, in charge from 11th December 1895.
„ W. C. Price, Extra Assistant Superintendent, 3rd grade.
„ G. W. Jarbo, „ „ „ 5th „
„ J. S. Swiney, „ „ „ 5th „
„ I. Murphy, „ „ „ 6th „
„ M. Gastaud, Sub- „ „ 1st „
„ T. W. Babonau, Sub-Assistant Superintendent, 1st „
Babu Amar Singh, „ „ 2nd „
„ Abinash Chander Bose, „ „ 3rd „
23 sub-surveyors and others.

Temporary Establishment.

60 inspectors, draftsmen, computers, etc.
80 field surveyors.

336. The party was divided into 3 sections. Section No. 1 (traverse and cadastral combined), under Mr. J. S. Swiney, commenced traverse work in the Pyuntaza subdivision of Pegu district on 1st November 1895, and cadastral operations a month later. A detachment of Burman *amins* from this section was sent, under Mr. J. Murphy, to complete the survey of the gardens and cultivated tracts scattered amongst the hills of the Kyaikto and Kyoupagu Circles of district Thaton. A further detachment from this camp, under Mr. M. Gastaud, was detailed for the topographical survey, on the 1-inch and 2-inch scales, of certain areas in the Thaton district, and commenced work on 20th November 1895. This section closed field work on 31st May. Section No. 2 (cadastral), under Mr. W. C. Price, began work on the large-scale survey of the town of Rangoon on 16th December 1895, and closed field work on 10th June 1896. Section No. 3 (traverse), under Mr. G. W. Jarbo, started traverse operations in the town of Rangoon on 6th November 1895, and closed field work on 30th May 1896.

337. The programme of the field season consisted of—

(*a*) The advance traverse survey of about 600 square miles in district Pegu (formerly Shwegyin district).
(*b*) The cadastral survey of about 500 square miles in district Pegu.
(*c*) The topographical survey of 238 square miles of hill and jungle tracts falling within or adjacent to the areas taken up cadastrally.
(*d*) Traverse of about 9 square miles of the Rangoon town large-scale survey.
(*e*) Detail survey of about 6 square miles of the Rangoon town, part on the scale of 50 feet and part on the scale of 100 feet = 1 inch.

* Mr. Penrose conducted his duties as officer in charge of the cadastral section in a highly satisfactory manner. Mr. Bell also worked efficiently both in the field and recess. The following members of the subordinate establishment are also worthy of special mention:—Munshi Fatteh Muhammad, the writer of the party, who performed his duties in a very satisfactory manner; Janardhan Rao, Sakhawat Hosain, and Chhatterpal Singh, sub-surveyors; Krishnaji Mahadeo, computer; and Srikishto Dey, Bahadur Singh, and Nasiruddin, of the cadastral establishment.

338. The demarcation arrangements were not quite satisfactory in parts of the Pegu district, owing to which, and the nature of the country, work came in rather slowly for the first month or six weeks, but was more than made up for later in the season. The demarcation of the hill gardens of district Thaton was very good, as was also that of the town of Rangoon.

339. In the Pegu district 714 square miles were traversed in the Pyuntaza township, embracing 281 *kwins*. The theodolite was set up at 13,693 stations, and 2,080 linear miles of double chaining was done. This work was checked by 53 observations for azimuth. Owing to the facilities for carriage, clay cylinders were used throughout for marking the stations.

340. Cadastral survey was completed in 182 *kwins* of the Pyuntaza township, and covered an area of 491 square miles. The work was checked by no less than 2,397 linear miles of chain measurements, of which 1,809 were done partly independently after the sheets had been received in office, and partly by the European assistants. In this portion of the work the proportion of cultivation to jungle is 1 to 3, and the average size of field is 0·56 of an acre, calculated on the cultivated area only. The remaining 374 square miles will be completed next season, thus completing the Pegu district.

341. The cadastral survey in the Thaton district comprised gardens and cultivated lands scattered in the hilly tracts of the Kyaikto and Kyoupagu Circles, embracing an area of 105 square miles in 70 *kwins*. The work was checked by 372 linear miles of chain measurements, of which 244 were done partly independently after the sheets were received in office, and partly by the European assistants. The proportion of cultivation to jungle was as 1 to 4, and the average size of the fields 0·40 of an acre. This work was very scattered.

342. In addition to the above, topographical operations on the 1-inch and 2-inch scales were carried out in the Thaton district as follows, *viz.*:— 336 square miles on 1-inch scale and 228 square miles on 2-inch scale. The work on the 1-inch scale was confined to the areas of hill tracts outside the area taken up cadastrally in sheets Nos. 421, 422, 476 and 477: this was undertaken in order to complete these sheets. That on the 2-inch scale consisted of hill areas both within and outside the cadastrally surveyed area in sheets Nos. 372 and 373.

343. The cost-rates of the work in the Pegu district are, for traverse survey, R41·1, and for cadastral survey R116·1, per square mile. That of the detail survey of the gardens and cultivated areas scattered in the hilly tracts in Thaton district was R159·7, which is comparatively high owing to the scattered and difficult nature of the work. The 1-inch and 2-inch surveys give a cost-rate of R28 per square mile. The rates as a whole compare favourably with those of last season.

344. The season's cadastral survey is mapped on 592 sheets in district Pegu, and 152 of district Thaton. Of these, the whole of the sheets of the latter district have been completed and are now being sent to Calcutta for publication. The whole of the Pegu district sheets are also completed, and only await final examination. They will be sent for publication very shortly. Tracings of all the villages of district Thaton, together with copies of area statements, have been furnished to the Settlement Officer. Tracings of 134 villages of district Pegu, together with their area statements, in duplicate, have been prepared, and will be despatched as soon as the tracings and copies of area statements of the remaining 48 villages are completed.

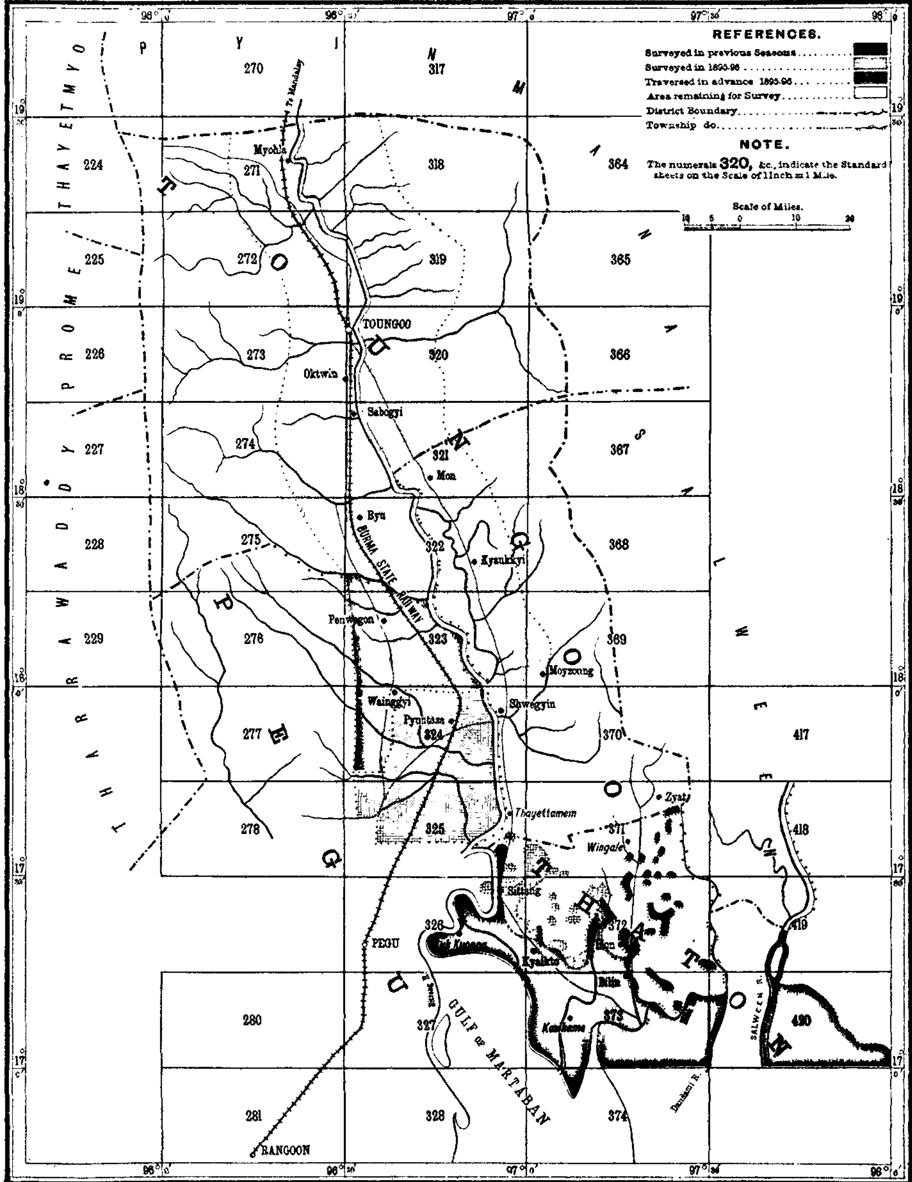
Of the 32 2-inch topographical sections of district Thaton that remained over for completion this year, 20 have been completed and sent to Calcutta for publication. The remaining 12 sections cannot be completed until next year, by which time the 1-inch survey of these sheets will be finished.

345. Dysentery and fever were very prevalent amongst the *khalásis*, the daily number in hospital from one or other of these causes averaging as high as 10 per diem. Nine *khalásis* died during the field season. The health of the assistants was good, with the exception of Mr. Gastaud, who suffered from dysentery part of the time, but managed to carry on his duties. The health of the men engaged in the Rangoon town survey remained good throughout the season, notwithstanding that small-pox was raging in the town in an epidemic and very severe form. They were provided with lines built specially for their use, and every sanitary precaution was taken to prevent any outbreak of sickness.

BURMA SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTS. THATON, PEGU, & TOUNGOO.

1895-96. No. 7 PARTY.



Reg. No. 485, S. I. D.—Jan. 97—550

Photo. S. I. O., Calcutta.

No. 321-S. 97.

346. The number of Burmans and Karens employed this year in the detail survey was 26. Of these, 1 inspector and 2 field surveyors were men already in possession of the 5 years' certificate; 1 inspector and 5 field surveyors were taken on from No. 12 Party when that party was transferred to India; 8 field surveyors were men who have now served 4 years outside Mr. Bridge's scheme, and 1 field surveyor 2 years; 3 men were apprentices during 1894-95, and 5 men were volunteers from the survey schools in Burma, entertained in 1894-95, to undergo a two years' training under the recent two years' scheme, in accordance with paragraph 2 of Revenue Department letter No. 597—4 S., dated 28th October 1893, from the Revenue Secretary to the Chief Commissioner, Burma, to the Surveyor General. The 2 inspectors worked very well and seemed to thoroughly understand their work, and the field surveyors worked satisfactorily and behaved well. For 2½ months at the commencement of the season the Burmans were employed in surveying gardens and scattered cultivation in the hilly tracts of district Thaton, in order to complete their experience, on the satisfactory completion of which they were transferred to assist in the survey of fields in the Pyuntaza township of district Pegu. Two field surveyors, Po Kin and Po Ba, had to be sent home in the middle of the season on account of malarial fever contracted in the jungles of district Thaton. Maung Thet Pu, one of the 6 Burmans who received a bonus last year, failed to rejoin, thus forfeiting the sum of R25-9-10 that had been placed in deposit for him. The average earnings of the Burman field surveyors is R34-1-6, being 11 per cent. higher than that of last year. The average monthly earnings of the Hindustani field surveyors for the same period was R48-15-7.

347. The Deputy Surveyor General inspected the party from 16th to 22nd January and again on his return from Upper Burma on 29th February: during these visits the whole of the records of the office of the Deputy Superintendent, together with those of the two camp offices then in Rangoon, were thoroughly examined, and the arrangements for carrying out the large scale survey of Rangoon town fully explained to the Deputy Surveyor General. In addition, Colonel Sandeman personally checked the field work of the town in several localities selected by himself, and in a demi-official note informed the Deputy Commissioner of Rangoon Town Lands of his satisfaction at the result.

348. The programme of the party for the coming field season is as follows:—in the Pegu district, 8 square miles will be traversed in Ananbaw circle and 374 square miles will be cadastrally surveyed on 16-inch scale in Ananbaw and Yehla circles, in order to complete the district. In the Toungoo district, 600 square miles will be traversed in circles Kwindala, Kyaukmaw, and Kyaukgyi, and 150 square miles will be cadastrally surveyed on 16-inch scale in Kwindala and Kyaukmaw circles. In Rangoon town, 2·7 square miles, exclusive of water area, will have to be traversed and surveys on the scales of 50 and 100 feet to the inch will be done of about 6¼ square miles.

In the Thaton district, 480 square miles will be triangulated and topographically surveyed on 2-inch scale, in standard sheet No. 372. Also 30 square miles on 2-inch scale in sheet No. 325, in all 510 square miles.

349. The Deputy Commissioner of Pegu, Mr. W. N. Porter, and the Deputy Commissioner of Thaton, Mr. R. C. M. Symms, are to be thanked for the cordial aid rendered by them to the Survey Department during the past season.

Rangoon Town Survey.

350. The large-scale survey of the town of Rangoon having been sanctioned, traverse operations were commenced under Mr. Jarbo on the 6th November 1895. The total area of ground to be traversed, including the area covered by water, is about 12·5 square miles, of which 9·5 square miles have been completed this year.

351. The traverse work is based on 18 stations and 27 intersected points fixed by triangulation, and the angular work was checked by 40 observations for azimuth. There are *6,000 stations in only 306 miles of chaining.* The triangulation stations are built of masonry and will be made over to the custody of the Municipality in due course. The traverse stations in the town proper are marked by small iron pegs driven into the ground and in the suburban portion

by clay cylinders embedded flush with the ground, and an iron peg driven into the centre.

352. It was calculated that half the total area of the town would be completed this year, and the remainder next year. This programme has been fully worked up to, for while the greater part of the traverse has been done, 6·3 square miles of the detail area have been disposed of, *viz.*, 2·6 square miles on the 50 feet scale, mapped on 120 sheets, and 3·7 square miles on the 100 feet scale, mapped on 60 sheets. The cost-rate of the detail survey is R11,003 per square mile for the 50 feet scale, and R3,848 per square mile for the 100 feet scale.

353. For the purpose of demarcation a Boundary officer has been appointed, who, with 2 demarcation officers to assist him, works under the orders of the Deputy Commissioner of Town Lands.

354. The field work has been thoroughly checked by 104 linear miles of check lines run by native inspectors, and 26 linear miles by European assistants. In addition to this the work has been independently checked by the Municipal officers, who were specially invited by the officer in charge to check the work whenever opportunity offered; and it is satisfactory to be able to record that so far not a single instance of error has been reported by the Municipality. Every sheet surveyed during the season has been well checked.

355. Of the 180 sheets comprising this season's work, the whole have been inked up, 180 fair copies of the field sheets and 81 working tracings containing the whole of the 16 blocks surveyed have been prepared. The preparation of a wall map of the town, in 10 sheets, on the scale of 300 feet to an inch, was also undertaken and 8 of the sheets were completed, the two heaviest being still in hand.

356. The total expenditure for the year on this survey was R64,966. The sum allotted for the whole work was R83,600, and a balance of only R18,634 remains. This is due to the fact that the late officer in charge under-estimated the expense of the 100 feet survey, having insufficient data to guide him; while his estimate of the cost of the 50 feet survey proved almost exactly correct, being based upon the cost of the Calcutta city survey on the same scale.

357. At the request of the Rangoon Municipality the officer in charge furnished an estimate of R2,000 as the cost of running a series of levels through the centres of the principal sheets of the town proper and suburbs at short intervals. As this work was not included in the original programme for the survey of the town, it was necessary to apply for a special allotment for the purpose, and the estimate having been sanctioned by the Municipality, field work was commenced on the 16th April 1896, and closed on 10th June 1896. Mr. J. Murphy, Extra Assistant Superintendent, was placed in charge of the work with a sub-surveyor to assist him, and between them they completed 4,984 linear miles this season out of the total of 76 miles required to be done.

358. The conduct of the men employed on the town survey was excellent throughout, there not being a single case reported of misbehaviour.

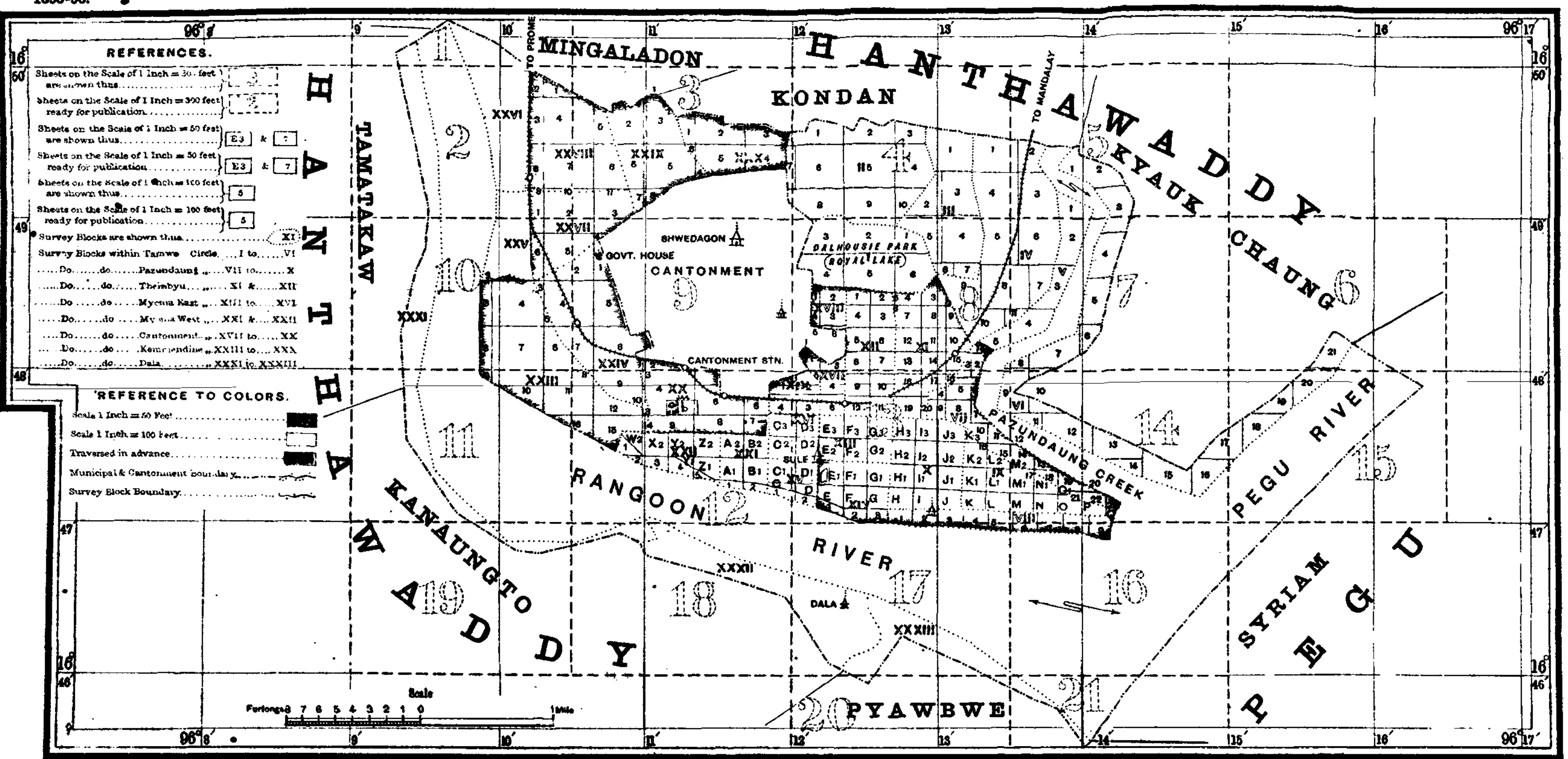
Cordial relations were maintained throughout with the officers of the Municipality, who rendered every assistance in their power to the survey; in connection with which the name of Mr. Shircore, the Registrar of Town Lands, should be mentioned; his knowledge of the town and readiness to supply information being of great assistance.

Toungoo Cantonment Survey.

359. At the request of the Chief Commissioner, the survey on the 16 inches=1 mile scale of the Toungoo Cantonment, comprising an area of 1·1 square mile, was commenced on 13th July 1896, and completed on 15th September 1896. The work was placed under the immediate supervision of Mr. J. S. Swiney, Extra Assistant Superintendent, and was satisfactorily carried out by 1 traverse and 1 detail surveyor. A tracing and area statement in duplicate have been made over to the Deputy Commissioner of Toungoo.*

* Mr. Gilbert Cooper reports well of the work done by Messrs. Price, Jarbo, Swiney and Gastaud, and states that the other assistants also gave satisfaction.

Of the subordinate establishment, Mr. Abreu, Azimullah Khan, Mahomed Umar, Nasib Beg, Mahbub Ali, Mamullah, Tha Dun Gyaw and Maung Hpokah are specially mentioned.



BURMA SURVEY.
INDEX TO THE SURVEY OF THE TOWN OF RANGOON.
1895-96.
No. 7 PARTY.
REFERENCES.
Sheets on the Scale of 1 Inch = 300 feet are shown thus
Sheets on the Scale of 1 Inch = 300 feet ready for publication
Sheets on the Scale of 1 Inch = 50 feet are shown thus
Sheets on the Scale of 1 Inch = 50 feet ready for publication
Sheets on the Scale of 1 Inch = 100 feet are shown thus
Sheets on the Scale of 1 Inch = 100 feet ready for publication
Survey Blocks are shown thus
Survey Blocks within Tamwe Circle ... I to ... VI
Do ... do ... Pazundaung ... VII to ... X
Do ... do ... Theinbyu ... XI & ... XII
Do ... do ... Myenu East ... XIII to ... XVI
Do ... do ... Myenu West ... XXI & ... XXII
Do ... do ... Cantonment ... XVII to ... XX
Do ... do ... Kemmendine ... XXIII to ... XXX
Do ... do ... Dala ... XXXI to XXXIII
REFERENCE TO COLORS.
Scale 1 Inch = 50 Feet
Scale 1 Inch = 100 Feet
Traversed in advance
Municipal & Cantonment Boundary
Survey Block Boundary
HANTHAWADDY
MINGALADON
KONDAN
TAMATAKAW
TO PROME
TO MANDALAY
KYAUK CHAUNG
SHWEDAGON
GOVT. HOUSE
CANTONMENT
DALHOUSIE PARK
ROYAL LAKE
CANTONMENT STN.
SULE
PAZUNDAUNG CREEK
PEGU RIVER
RANGOON RIVER
KANAUNGTO
DALA
SYRIAM
PEGU
PYAWBWE
Scale
Furlongs 8 7 6 5 4 3 2 1 0
1 Mile
Reg No 654 S. I. D.—Feb 97.—550.
Photo. S. I. O., Calcutta
No. 336-S. 97.

N. W. P. & OUDH SURVEY.

INDEX TO THE LAND RECORDS SURVEYS IN N. W. P. & OUDH.

1894—96.



REFERENCES.

Survey and Recordwriting Completed
Survey only
Province or State Boundary
Division do
District do

NOTES.

The numerals 118, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile

The figures and lines in strokes represent the numbers & limits of Engraved sheets of Indian Atlas

T I B E T

N E P A L

B E N G A L

R A J P U T A N A & C. I. A G E N C Y

P U N J A B

CENTRAL PROVINCES

SAHARANPUR, MUZAFFARNAGAR, MEERUT, BIJNOR, MORADABAD, BULANDSHAHR, ALIGARH, MUTTRA, AGRA, ETAH, MAINPURI, ETAWAH, FARRUKHABAD, BUDAUN, BAREILLY, PILIBHIT, RAMPUR, KASHIPUR, ALMORA, TEHRI, SRINAGAR, SHAHJAHANPUR, HARDOI, KHERI, SITAPUR, BAHRAICH, GONDA, BARA BANKI, LUCKNOW, UNAO, CAWNPORE, JALAUN, HAMIRPUR, BANDA, JHANSI, LALITPUR, FATEHPUR, RAE BARELI, FYZABAD, SULTANPUR, PARTABGARH, ALLAHABAD, BASTI, GORAKHPUR, AZAMGARH, JAUNPUR, GHAZIPUR, BALLIA, BENARES, MIRZAPUR

Scale of Miles

Reg. No. 351, S. I. D.—Feb. 97.—350.

Photo. S. I. O., Calcutta.

No. 337-S. 97.

NORTH-WESTERN PROVINCES AND OUDH.

360. In August 1894 the Government of the North-Western Provinces and Oudh applied to the Government of India for the services of Mr. G. B. Scott, Deputy Superintendent, Survey of India, as Superintendent of Land Records Surveys, to professionally control, under the orders of the Director, Department of Land Records, the surveys which had already been initiated in those Provinces by *patwári* agency. Certain officers of the Provincial Branch of the Survey Department, one in each district, were deputed for employment under Mr. Scott, to supervise the operations. These proposals were approved by the Government of India, and Mr. Scott was transferred to the North-Western Provinces from the 1st October 1894.

361. The Superintendent of these Land Records Surveys is responsible to the Deputy Surveyor General, Revenue Branch, that the professional standard of the survey, which is based on traverse plots furnished by parties of the Survey Department, is maintained, although the agency consists of the village *patwáris*. The proposal that the Deputy Surveyor General should complete the chain of professional supervision over these surveys was made by the North-Western Provinces and Oudh Government, and the Government of India endorsed the proposal.

362. As these surveys are in all respects professional, it has been considered desirable to include a brief report on the operations in the General Report of the Survey Department. As no report was submitted last year, the following deals with the operations of the past two seasons from the date of Mr. Scott's assumption of charge.

363. The provincial officers who were deputed to the charge of the work in each district were Messrs. T. F. Freeman, in Meerut; W. Skilling, in Bahraich; N. Bedford, in the Lalitpur subdivision of Jhansi; O. D. Smart, in Kheri; and P. C. Smart, in Shahjahanpur.

364. The Survey Department is dependent on the results of these Land Records Surveys for the materials required to map topographically nine districts which have never been mapped, and for the revision of the standard sheets of the rest of the Provinces before the issue of new editions.

365. The surveys are based on traverse skeleton plots provided by Nos. 2 and 8 Parties of the Imperial Survey Department. The survey stations are marked by stone prisms or clay cylinders, buried to within a few inches from their tops. It would certainly have been an advantage if all survey marks, on boundaries at least, had been marked entirely by stones, as the cylinders tempt the destructive instincts of village boys. In most districts, the tri-junctions of villages are marked by masonry platforms. Heavy stones have been used in some *parganas* of Meerut district and should be indestructible. All tri-junctions have been adopted as survey stations.

366. Owing to the traverse surveys in Bahraich and Meerut districts having commenced simultaneously with the detail survey in season 1894-95 and in Shahjahanpur and Kheri districts in 1895-96, much delay was caused, as the *patwáris* could not begin the detail surveys in their circles till plots were furnished. As the traverse work is now well in advance of the detail survey, no delay is anticipated from this cause in future.

367. Several disputes arose regarding boundaries, and these were generally caused by attempts to lay down the boundaries in accordance with old settlement maps, which often differed seriously in contiguous villages. All such disputes, when not amicably arranged by the disputants themselves, were reported to the district officers, and traces, showing both lines of boundary claimed and the fields and other items along and near the disputed ground, were sent with the report. After they had been settled, the final boundaries were re-surveyed and the maps and records corrected accordingly.

368. The detail surveys were made on the scale of 16 inches = 1 mile, except in the case of one village in Meerut district in which the average size of fields was 0·18 of an acre, and which was in consequence surveyed on the 32-inch scale.

369. The outturn of both seasons is given in the following statement, which

shows the areas of survey and record-writing for each season, and the average cost-rate of the work per square mile :—

DISTRICTS.	Cadastral Survey, 16 Inches = 1 Mile.				Record-writing.			Average cost per square mile.		
	1894-95.		1895-96.		1895-96.					
	Number of villages.	Area in square miles.	Number of villages.	Area in square miles.	Number of villages.	Number of fields.	Area in square miles.	R	a.	p.
Meerut	683	1,003	562	770	1,108	1,403,660	1,566	31	6	8
Jhansi (Lalitpur Sub-division)	297	838	230	467	527	453,127	1,305	27	0	0
„ (Gursarai and Kakarbai Estates)	...	...	68	193	68	77,853	193	28	0	0
Bahraich	674	598	347	402	1,008	1,202,074	973	47	14	4
Sitapur (alluvial mahals)	...	...	98	134	98	95,554	134	47	14	4
Shahjahanpur	...	...	906	704	906	584,576	704	47	5	0
Kheri	...	...	469	430	469	294,292	430	43	10	6
Bijnor	94	162	95	169	Records written by Settlement Officer.			...	...	...
Totals	1,748	2,601	2,775	3,269	4,134	4,111,136	5,305			

370. The total expenditure incurred in each district, and in superintendence and head-quarters, including the entire cost of instruments, tents, furniture, stationery, etc., is as follows :—

	R	a.	p.
Superintendence and Head-Quarters Establishment	53,379	10	8
Meerut (including Mr. Freeman's pay and allowances)	61,203	6	3
Jhansi (Lalitpur Subdivision)	36,624	3	2
„ (Gursarai and Kakarbai Estates)	5,383	15	0
Bahraich and Sitapur Mahals	63,326	3	10
Shahjahanpur	40,786	14	2
Kheri	23,382	3	0
Total	2,84,086	8	1

371. The detail survey is performed by *patwáris*, and in each district the first months of the field season were employed in training them, at various centres, before work was commenced. The total number so trained and employed up to date was 1,606, and in addition to these a large number of *kanungos* were also put through a course of training. *Amins* are never employed without special sanction, but this has been done in some instances, as in Lalitpur. In most districts the pay of the *patwáris* ranges from R7 to R12 per month. In Bahraich it ranges from R1 to R12, a large proportion receiving less than R5. To encourage them to work better, the Board sanctioned a proposal that they should be paid according to outturn, and a rate was formed on the basis that a man working fairly well could earn R8 per month. The average outturn by *patwáris* per diem ranged from 5 to 6 acres in December to 16 acres in the later months. The average number of fields written up in *khasra* ranged from 20 to 45 per man per diem.

372. When the areas of *patwáris'* circles were too large for one man to complete, or when work commenced late in the season, *patwáris* from *tahsils* where work had not yet begun were brought in to be trained and to assist in the survey. The men so trained will be ready to commence work as soon as field work re-opens, thus saving considerable time. It has been arranged that in future, whenever time permits, *patwáris* will have two years in which to complete their circles, in order to admit of their being more thoroughly trained in area-estimating and drafting than has been possible hitherto. This will necessitate the extension of operations over double areas and render it more than ever desirable to have assistants from the Survey Department in every district where the area exceeds 500 or 600 square miles.

373. Over every 16 to 20 *patwáris'* circles is an inspector, trained in the Survey Department, who has to check the survey and record-writing. Wherever they were available for supervision, *kanungos* aided in the examination of *khasras*. In Meerut district, Deputy Collectors also assisted. The inspectors check the survey while in progress by running check lines across several sections of each plan and testing the field cuttings and offsets. The survey officer has too little time to devote to personally checking the survey, but its accuracy is examined by the final check lines run in each village after the plan has been received in office. These lines are run by men who have no access to the plans, and the measurements are recorded in field books from which plots are made in office, traced and applied to the plan by the survey officer. Mr. Scott personally examined a large number of these independent *partals*, and found the work on the whole very accurate in every district. The *khasra* writing is also checked by inspectors while in progress, and the survey officer visits as many villages as possible for the same purpose.

374. The inking up of the field plans has been done almost entirely by professional draftsmen. Three sets of tracings are being prepared in each district: one showing soils, one for the settlement officer, and one for the *patwáris*. An outline trace showing physical features will also be prepared for the Surveyor General for correction of topograpical maps if required. It has been decided that the original plans are not to be reproduced by photo-zincography, as the cost is estimated at R50,000 per annum.

375. The acre having been adopted as the standard of measure in all districts coming under survey, all statistics are being prepared in that measure. They have been estimated and checked exactly as is done by the cadastral parties of the Survey of India. The totals of field areas of every village are compared with area obtained by planimeter and with the traversed area ± offsets, and passed if the three agree within 1 per cent. of each other.

376. Mr. Scott examined field work in Shahjahanpur, Kheri, Bahraich, Lalitpur and Bijnor in December, January and February, and office work in these districts and in Meerut, Sitapur and Jhansi in May and again in July and August. He also visited Basti and Barabanki in July to consult with the Collector and Deputy Commissioner as to the best method of carrying out the correction of the village maps by *patwáris*.

377. Mr. Scott brings to notice the energy, zeal and ability with which all the survey officers carried on their duties, often under difficult circumstances, and even during sickness, from which all suffered at times.

378. During November and January two classes of junior civilians were personally instructed by Mr. Scott in the use of survey instruments and in village survey. After the classes closed the officers were attached for a month to the survey parties in the several districts.

379. The programme of operations for the ensuing season is as follows:—

The cadastral survey and record-writing in the Meerut district and the Lalitpur subdivision of the Jhansi district will be completed, and the survey establishment will be available for work in other districts in 1897-98. In Bahraich, the Fakharpur and Nanpara *parganas* will probably be completed and work begun in other *parganas*. The 80 square miles remaining of the Sitapur alluvial *mahals* will also be completed. In Shahjahanpur, the Tilhar *tahsil* and portion of Pawayan will be completed, and the training of *patwáris* and, if possible, the survey, will be commenced in the remaining area. In Kheri, about 700 square miles will probably be completed in *tahsils* Mohamdi and Lakhimpur. In Bareilly, the Faridpur, Bareilly and Mirganj *tahsils* will probably be completed, an area of about 750 square miles.

The settlement maps of the remainder of the Pilibhit district, and of the Mainpuri, Etah, Etawah, Cawnpore and Azamgarh districts, are to be examined and reported on by the Superintendent.

Arrangements will also be made for training the *patwáris* of the Domariaganj *tahsil* of Basti, and examining the work in connection with the revision of the survey of villages where the alterations in fields owing to the *halbandi* system of tenure render a re-survey necessary, provided the *patwáris* are available for the work. The re-survey will be made on skeleton plots prepared from traverse data of the previous survey by the Survey of India Department.

380. The Deputy Surveyor General inspected the land records cadastral surveys in district Bahraich and Meerut in December 1895. His criticisms of the work are contained in a note dated 31st December 1895, but on the whole he was well satisfied with what he saw. Mr. G. B. Scott and the survey officers under him have done good work. As a reward for his services Mr. T. F. Freeman has been appointed a Deputy Collector in the Provinces.

TRAVERSE SURVEYS.

NORTH-WESTERN PROVINCES AND OUDH.

No. 2 Party.

Personnel.

Captain J. M. Fleming, S.C., Officiating Deputy Superintendent, 1st grade, in charge from 1st January 1896.
Mr. W. S. Buttress, Extra Assistant Superintendent, 2nd grade, in charge from 17th November to 31st December 1895.
" G. E. Parker, Extra Assistant Superintendent, 5th grade, in charge up to 16th November 1895.
" F. B. Powell, Sub-Assistant Superintendent, 1st grade.
" C. H. G. Johnson, Sub-Assistant Superintendent, 2nd grade.
" A. H. Peychers, Sub-Assistant Superintendent, 3rd grade.
73 sub-surveyors, computers, etc.

381. This party was transferred from Bengal under orders contained in Government of India Order No. 2482—58-12, dated 28th August 1895, for employment on traverse surveys in the North-Western Provinces and Oudh.

382. The establishment was composed of men from the late Nos. 2 and 8 Parties, from the Orissa detachment, and such men as could be spared from No. 12 Party and the late North-Western Provinces detachment, now No. 8 Party. Several recruits were also obtained locally. The party assembled at Shahjahanpur during October 1895, under the charge of Mr. G. E. Parker, supervised by Mr. G.B. Scott, Superintendent of Settlement Surveys. On the 17th November Mr. Buttress arrived from Burma and took over charge of the party until the arrival of Captain Fleming on the 1st January 1896, who continued in charge during the remainder of the year.

383. Traverse operations were carried on in the Shahjahanpur and Kheri districts, in each of which a separate camp was at work. The object of the survey was to supply the settlement surveyors with plots of the different villages showing the various traverse stations fixed, thus supplying the *patwáris*, by whom the detail survey is carried out, with a large number of fixed points on which to base the field-to-field survey.

384. The traverse stations have been marked by stones roughly dressed except for a length of five inches at one end where they were cut to a prism shape, and also by baked pottery cylinders locally made. The stones were buried at tri-junctions of villages where these were not marked by *pucca* masonry platforms, as was usually the case and at one satellite station of each tri-junction, as well as at two intermediate stations when the distance between tri-junctions was great. These stones were about two feet in length, and were obtained from stone contractors at Chunar, their average cost with carriage being annas 6-9 each. Altogether 10,399 stones were used; 6,355 in Shahjahanpur and 4,064 in Kheri. The remaining stations were marked by 24,025 baked pottery cylinders. In the sandy soil found in both districts these cylinders will not, it is feared, prove very permanent marks, as they can be easily drawn out even when completely buried.

385. The programme for the season comprised the completion of 1,500 square miles of traverse in Shahjahanpur and 1,000 square miles in Kheri, with the supply, as early as possible, of plots of about 500 square miles in each district, to enable the *patwáris* to commence the detail survey. In order to comply with the requirements of the Settlement Department, the country was divided up into smaller main and sub-circuit divisions than is usually the case, and the sub-surveyors were moved about a great deal at the commencement to secure the completion of at least one village in each *patwári* circle, on which the *patwáris* could set to work. The traverse data, on receipt in the camp offices, were at once roughly computed out and plotted sheets supplied as quickly as possible. By the end of February, the majority of the village plots required had been made over to the local survey officers; and during the field season 1,170 16-inch

N. W. P. & OUDH SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DIST. SHAHJAHANPUR.

1895-96. No. 2 PARTY.

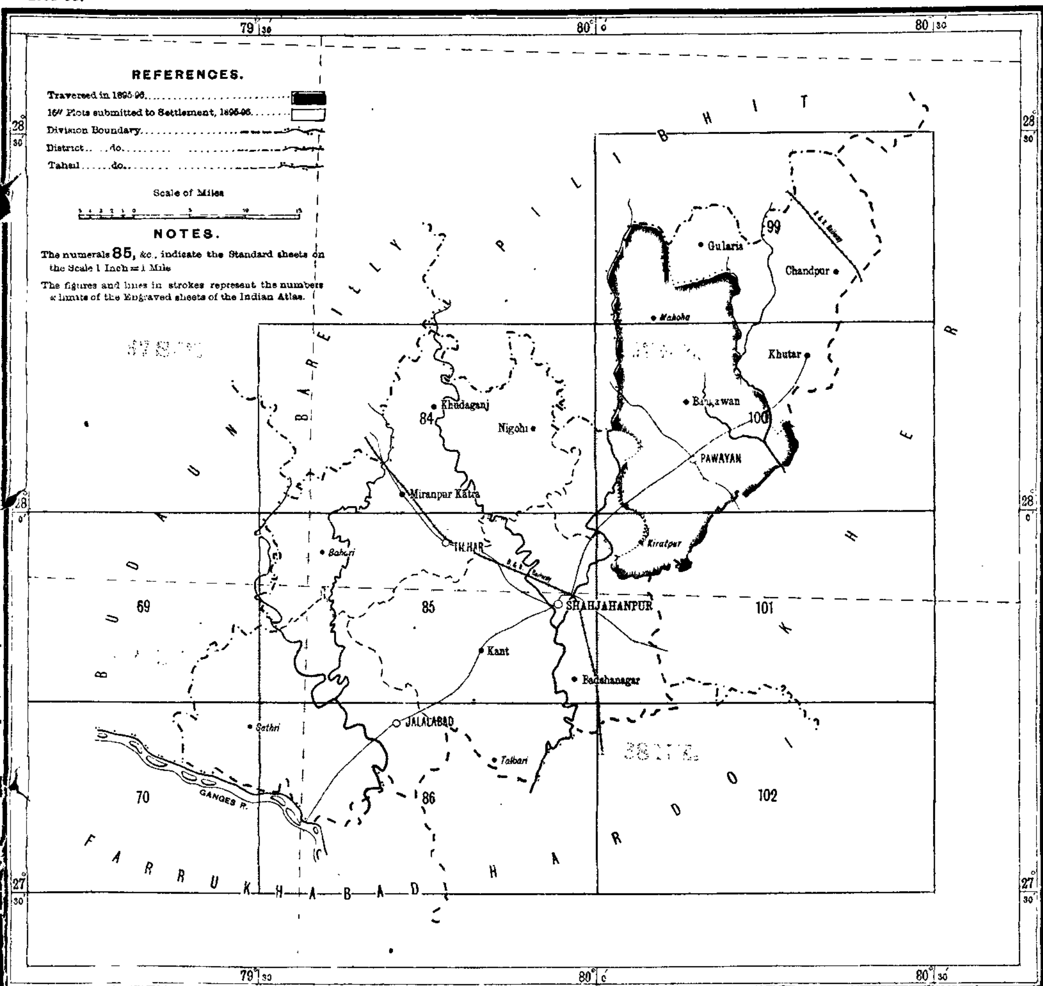
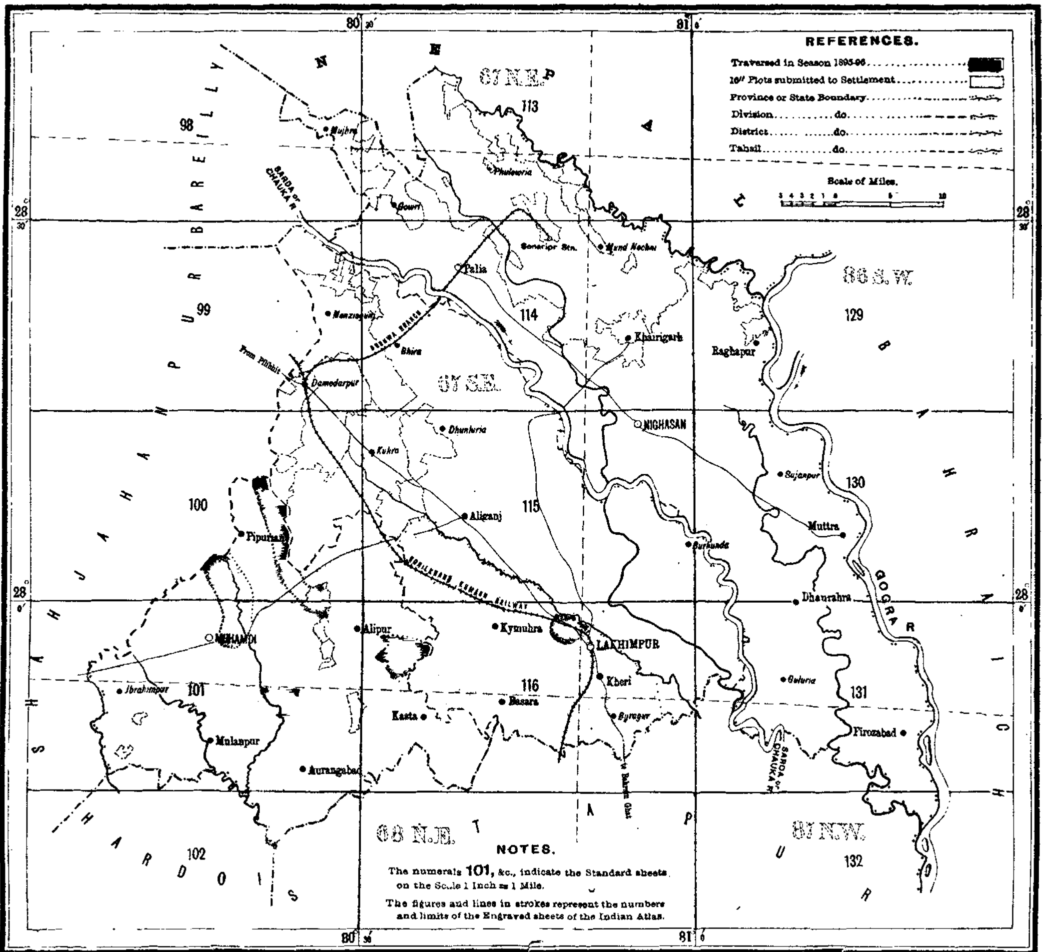


Photo. S. I. O., Calcutta

No. 308-S. 97.

N. W. P. & OUDH SURVEY.

1895-96. **INDEX TO THE TRAVERSE SURVEY IN DISTRICT KHERI.** No. 2 PARTY.



Reg No. 549, S. I. D.—Jan. 97.—550

Photo. S ..., Calcutta.

sheets in the Shahjahanpur district, comprising an area of about 718 square miles, and 661 sheets in the Kheri district, 420 square miles in area, were forwarded to the Settlement Department.

386. Besides the loss of time incurred in continually moving about the field hands, a great amount of extra work was incurred by the necessity for re-computing the traverses at the beginning of the recess, the computations having been roughly closed for plotting purposes. The ordinary recess work was thus much delayed.

387. The establishment in both camps, and particularly the Kheri one, was most inferior; and the necessity for despatching the men to their work as they arrived, without any preliminary training, with a view to the early obtaining of traverse data for the plots, had disastrous results in the immense number of revisions found necessary. The chaining was particularly bad, the untrained men all showing a tendency to strain the chains excessively, thus rendering all the distances too short. The necessity for rapidly computing the traverses received detained the European staff, who would otherwise have been on inspection duty, at office work in camp till late in the season.

388. The demarcation in both districts, where it existed at all, was most imperfect, and little or no assistance was rendered to the party by the inhabitants. On the other hand, they rarely obstructed the work, and their general attitude may be described as one of indifference.

389. The line-clearing squads never really got ahead of the surveyors, and in many cases the latter had to clear their own traverse lines before commencing work. As a guide to the boundaries, rough sketch maps showing the general run of *pargana* and *tahsil* limits, and the relative position of the villages, were obtained from the Civil authorities, and traces from these were issued to each sub-surveyor.

390. The tract under survey in both districts was, generally speaking, flat and under cultivation, though in the north of Shahjahanpur and all over the Kheri district there were occasional patches of scrub jungle, and parts of Kheri were somewhat undulating and broken ground. The usual crops were wheat, gram and dal, with a good deal of poppy. The crops were generally poor.

391. Double chaining with chains of 100 and 93 links, respectively, was carried out in the main and sub-circuits in both districts. The first *pargana* surveyed was measured throughout with two chains, but latterly only one chain was employed on village circuits, with no perceptible deterioration in the results obtained.

392. The origin of the survey to which the rectangular values of the main and sub-circuit stations have been referred in both districts was the intersection of the parallel of 28° N. latitude with the meridian of 80° E. longitude.

393. The outturn of work for the season is shown in the following statement:—

Districts.	Number of villages.	Number of sub-traverses.	Number of traverse stations.	Area in square miles.
Shahjahanpur	2,111	1,646	26,093	1,501
Kheri	982	1,130	15,244	946
TOTALS .	3,093	2,776	41,337	2,447

The average area of the village circuits in Shahjahanpur was 0·71 of a square mile, and in Kheri 0·96. The number of linear miles traversed was, in Shahjahanpur 5,629, and in Kheri 3,475. The number of azimuths observed in the two districts was 285.

394. The programme of 1,500 square miles was thus completed in Shahjahanpur, but in Kheri the outturn fell short by about 54 square miles.

395. The cost-rates per square mile for the whole area are R5-10 for stone embedding and R26-6 for traversing, or R32 for the combined operations. As these figures include heavy transfer charges, and payment for a large

number of boundary marks remaining in hand, it is hoped that the rates in the coming year may be considerably reduced.

396. The health of the party during the year was generally good. Four deaths occurred; one with the head camp and three with the Kheri camp, to which the hospital assistant was attached.

397. The Deputy Surveyor General visited the head-quarters and Shahjahanpur camps during December 1895, and inspected the recess office at Mussoorie towards the end of the recess. Captain Fleming had not joined on the former occasion. The work thus got a bad start with a newly organised and untrained establishment, and the outturn was not so good as it might have been under more favourable circumstances. The Deputy Surveyor General is confident that under Captain Fleming's management the establishment will rapidly improve, as also the work, both in quality and quantity.*

No. 8 Party.

Personnel.

Mr. J. S. Pemberton, Officiating Deputy Superintendent, 2nd grade, in charge.
„ W. J. O'Sullivan, Extra Assistant Superintendent, 3rd grade.
„ G. Rae, Sub-Assistant Superintendent, 2nd grade.
„ P. Williams, Sub-Assistant Superintendent, 3rd grade.
„ P. L. Causley, Sub-Assistant Superintendent, 3rd grade.
71 sub-surveyors, computers, etc.

398. In October 1895 the traverse survey detachment in the North-Western Provinces and Oudh, which had been employed during the preceding seasons in districts Meerut and Bahraich, was raised to full strength and its designation changed to No. 8 Party. It has been under the charge of Mr. J. S. Pemberton throughout the year.

399. The programme for the season comprised the completion of the traverse survey of district Meerut and as much as could be done in district Bareilly, by camp No. 1 under Mr. Pemberton, and the completion of district Bahraich, together with a certain area of alluvial *mahals* in district Sitapur, by camp No. 2 under Mr. O'Sullivan.

400. The system of survey followed in all the districts was the same as in the preceding season, *viz.*, a *mauzawar* survey with each *mauza* or village cut up into sub-traverses at an average distance of half a mile apart. The object of the survey was, as heretofore, the supply of skeleton plots for settlement surveys by local agency.

401. The recess office of the party closed at Naini Tal on the 19th October 1895, and field operations commenced almost simultaneously in the Meerut, Bahraich and Sitapur districts about the 1st November, the work in district Bareilly being taken up later on.

402. The area remaining to be traversed in district Meerut was completed with the exception of the *khadar*, or alluvial lands, lying along the Ganges in *tehsil* Mowana, 130 square miles in area approximately, where operations were impossible owing to the tract being under water. This area will be completed next season. The work in the Meerut district included a traverse survey of Meerut city and the area lying within municipal limits, in which there are scattered assessable lands.

Skeleton plots of the entire area traversed during the season, *viz.*, 492 square miles, were completed and made over to the Settlement Department, and also those of 50 square miles traversed in the preceding season in *tehsil* Gaziabad, which had been held over for revision.

The demarcation in the Meerut district was defective throughout, except in the case of tri-junction points, which were well marked, with few exceptions, by blocks of stone.

403. In the Bareilly district, the first *parganas* taken in hand were Shahi, Ajaon and Sarauli north, in *tehsil* Mirganj, Chaumahla, Kabar, Sirsawan and Richha in *tehsil* Baheri, and Faridpur in *tehsil* Faridpur. Towards the close of

* Captain Fleming reports that Mr. Buttress conducted the duties of his camp to his satisfaction, both in field and recess, and has spared no personal trouble to push on the work. Messrs. Powell and Johnson have also worked well and willingly and carefully carried out any work given them.

Of the native establishment the following are specially mentioned:—Mahomed Ali, Ram Sarup, Basant Rai, Gokal Chand, Abdur Rahaman and Ghaus Mahomed, sub-surveyors; Govind Balwant Joshi, Annada Prasad Ghose, Bhajan Lall, Ram Charan and Dharam Nath, computers; Abdul Kayum, draftsman, and Jagneswar Bhattacharjee, writer.

N. W. P. & OUDH SURVEY.

1895-96. **INDEX TO THE TRAVERSE SURVEY IN DISTRICT MEERUT.** No. 8 PARTY.

REFERENCES.

Traversed during Season 1894-95.

... Do. .... do. ... do .. 1895-96.

District Boundary.

Tahsil ..... do.

Pargana ... do.

Scale of Miles.

NOTES.

The numerals 18, &c., indicate the Standard sheets on the Scale 1 Inch = 1 Mile.

The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas

Reg No. 423, S I. D.—Jan 97—550

Photo. S. . , Calcutta

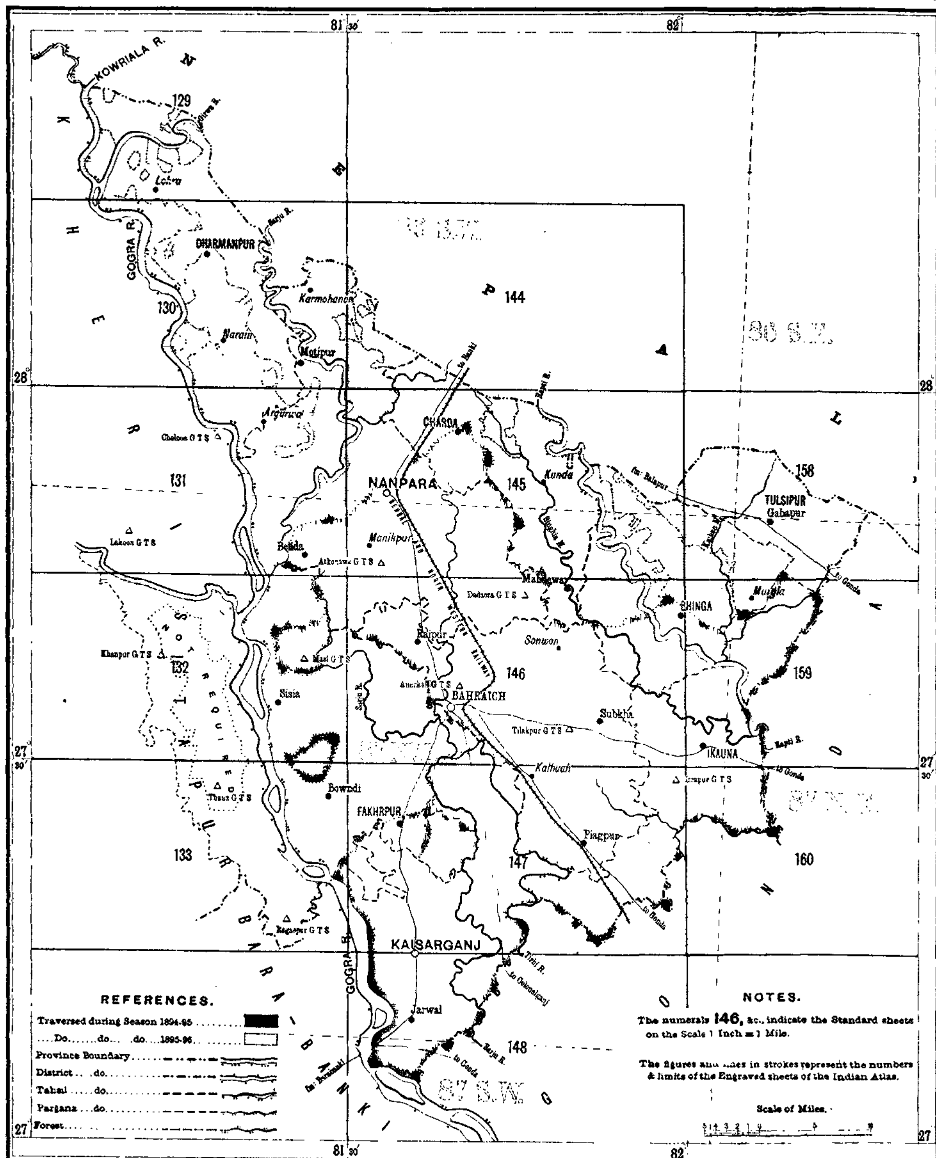


No. 306-S. 97.

N. W. P. & OUDH SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICTS BAHRAICH & SITAPUR.

1895-96. No. 8 PARTY.



Reg. No. 456 S. I. D.—Jan. 97—560.

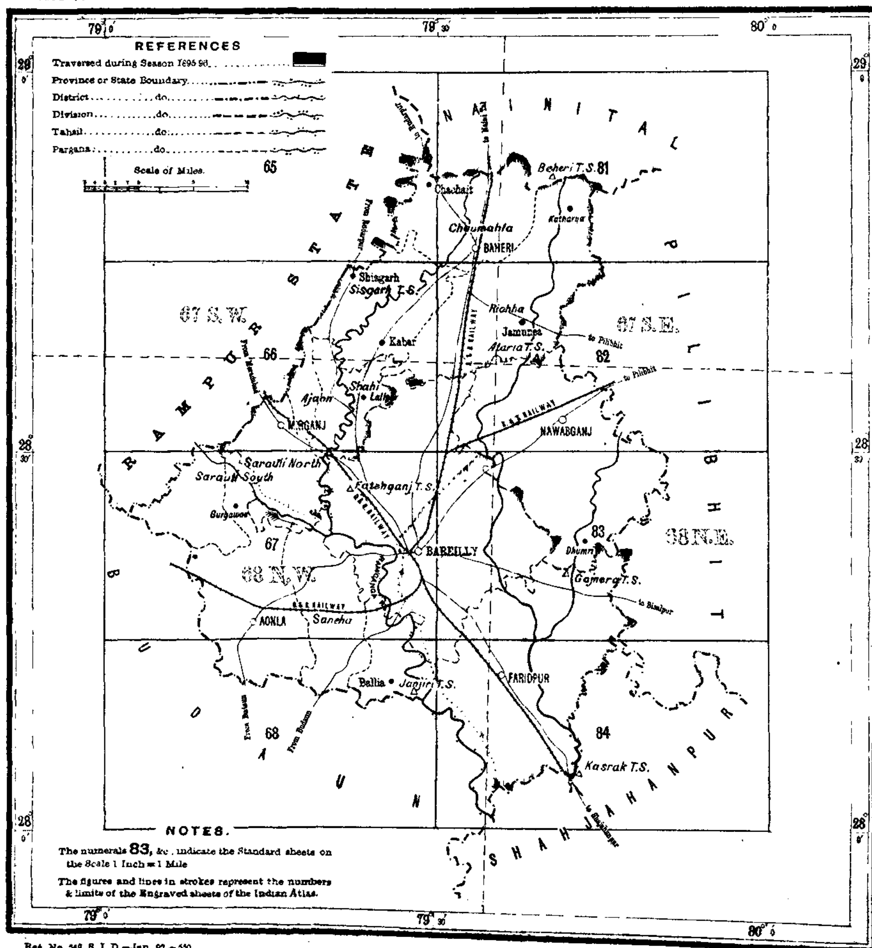
Photo. S. I. O., Calcutta

No. 320-S. 97.

N. W. P. & OUDH SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT BAREILLY.

1895-96. No. 8 PARTY.



Reg No. 549, S. I. D.—Jan. 97.—550

Photo. S. I. O., Calcutta.

No. 305-S. 97.

the field season, the Superintendent of Land Records asked that as much as possible might be traversed in *pargana* Bareilly also, as the date of expiry of settlement of that *pargana* was prior to that of the others. Accordingly 139 square miles of traverse, beyond the area originally contemplated, were completed during the season.

Skeleton plots of the entire area surveyed in district Bareilly, *viz.*, 841 square miles, have been prepared and will be made over to the Settlement Department when required.

The demarcation was found to be fairly good, but insufficient, inasmuch as the number of pillars between tri-junction points were much too few to be a good guide for laying down traverse lines. Tri-junction points were well marked by stones.

404. In the Bahraich district, no difficulties whatever were experienced, and the progress of the work was well sustained throughout the season. The demarcation, as in the previous season, was carried out in advance and well done.

The plotting, both on the 4-inch and 16-inch scales, of the entire remaining area in the district, was completed long in advance of the Settlement Survey requirements, and the plots were all made over by the 8th October 1896.

405. The revised settlement of the Sitapur district being at the time in progress, it was found that the old settlement maps were quite useless owing to the great changes caused by river action. At the request of the Deputy Commissioner, and with the sanction of the Board of Revenue, the preliminary traverse of certain *mahals* was undertaken by the party. The area traversed amounted to 216 square miles, of which the 4-inch and 16-inch plots were prepared and made over to the Settlement Officer by the end of January 1896. Sufficient demarcation had been done to meet traverse requirements, but no more.

406. The total outturn for the season in all four districts is shown in the following statement :—

DISTRICTS.	Number of villages or blocks.	Number of sub-traverses.	Number of traverse stations.	Area in square miles.
Meerut	370	811	6,746	480
„ (river blocks)	5	...	87	12
Bareilly	1,186	965	14,238	841
Bahraich	841	834	11,184	941
„ (river blocks)	3	...	671	141
„ (forest blocks)	7	...	79	312
Sitapur	143	252	3,784	216
TOTALS	2,555	2,862	36,789	2,943

407. The total cost of the year's operations amounts to R71,136-8-7, giving a cost-rate per square mile of R24-2-9, including forest areas. Excluding these areas the cost-rate per square mile is R27-0-7.

408. The total number of permanent marks used was 5,793 stones and 26,352 cylinders. These were of exactly the same description as those of last season, and were used similarly, except that in the Bareilly district, only one, instead of two stations, next to tri-junction platforms of villages was marked by a stone, and where these were more than half a mile apart two consecutive intermediate stations were similarly marked. It was found necessary to adopt stringent measures for the preservation of the marks, and instructions to this end have been issued by the Board of Revenue.

409. Azimuths were observed on main and sub-circuits to east and west stars at an average distance of 35 stations, or about 5 miles apart, and invariably at junctions of main and sub-circuits. The total number of observations for azimuth was 215. Fifteen G. T. stations were connected with the season's work.

410. As usual, a standard for testing chains was laid down in every camp with the aid of steel standard bars. Every chain given out for use was first tested and corrected if necessary. Every field surveyor was furnished with an

extra test chain, with which he checked his chain in use daily, the test chain itself being checked against the standard in camp once a week.

411. During the recess, a sub-surveyor was deputed to make a traverse survey of 24 villages scattered over the Bhurtpore State, the approximate area of which is 42 square miles. At the close of the year the records of 15 villages had been received and it is expected that the remainder will be completed by the 20th November 1896. The object of this survey is to test the accuracy of the detail survey and village boundaries shown on the local *patwári* survey maps, with a view to their adoption in the new settlement in the event of their proving correct. For this purpose all bends of boundaries have been connected by offsets to the traverse lines, and also the corners of fields passed through, by two lines of sub-traverses carried through each village. These will all be plotted on the scale of the *patwári* maps and a comparison made between the two surveys and all differences shown. The cost of this work will be reported on when completed.

412. Field work was brought to a close by both sections on the 15th April 1896, and the recess office opened at Naini Tal on the 20th April.

413. The party was inspected by the Deputy Surveyor General, Revenue Branch, in the field in December 1895, and again during the recess in September 1896. He was satisfied with all he saw on both occasions, and found the work progressing well under Mr. Pemberton's efficient management.*

CENTRAL PROVINCES.

No. 9 Party.

Personnel.

Mr. E. J. Jackson, Superintendent, 2nd grade, in charge.
„ H. Dowman, Extra Assistant Superintendent, 2nd grade.
„ P. A. Peters „ „ „ 6th „
„ C. George Sub- „ „ 1st „
„ J. Donaghey „ „ „ 3rd „
30 sub-surveyors, 3 draftsmen and 20 computers.

414. The Chief Commissioner asked for a further retention of this party for traverse work in the Central Provinces during the field season of 1895-96, and the Government of India having sanctioned his request, arrangements were made to continue the traverse survey of 1,199 scattered villages in *zamindari* estates in districts Sambalpur, Bilaspur, Raipur and Chanda, also 45 villages in Pachmarhi, 5 in Gorakhghat, and 100 in Pagara Jaghir under the Court of Wards in the Chhindwara district.

415. The detachments left Kampti on the 15th November 1895 for districts Sambalpur, Bilaspur and Raipur. The head-quarters office started for the field on the 21st November for Raipur. The establishments returned to recess quarters on the 15th May 1896, except the Chhindwara detachment, which returned to Kampti on the 24th June.

416. As in previous seasons, the object of the traverse surveys has been to furnish the Settlement Department with skeleton plots on the 16-inch scale, giving a number of fixed points on which to base the surveys of the fields which are carried out by *patwáris*. The traverse lines closely follow the village boundaries, and the sub-traverses within the polygons are as a rule about 30 chains apart, so that the *patwáris* have little or no trouble in connecting their work.

417. The traverse operations presented considerable difficulty, owing to the villages being scattered, as will be seen from the index maps. The Sambalpur camp traversed 303 villages comprising an area of 395 square miles in 46 *zamindari* estates scattered over 2,000 square miles. The Bilaspur camp completed 410 villages in 29 *zamindari* estates covering an area of 1,110 square miles scattered over 3,848 square miles. In Raipur 383 villages in 57 *zamindari* estates were traversed, embracing an area of 923 scattered over 4,592 square miles. The 155 villages traversed in the Chhindwara district covered an area of 394 square miles.

418. The season's work lay in five districts and the villages, as in previous seasons, were scattered; this caused delay in marching great distances to

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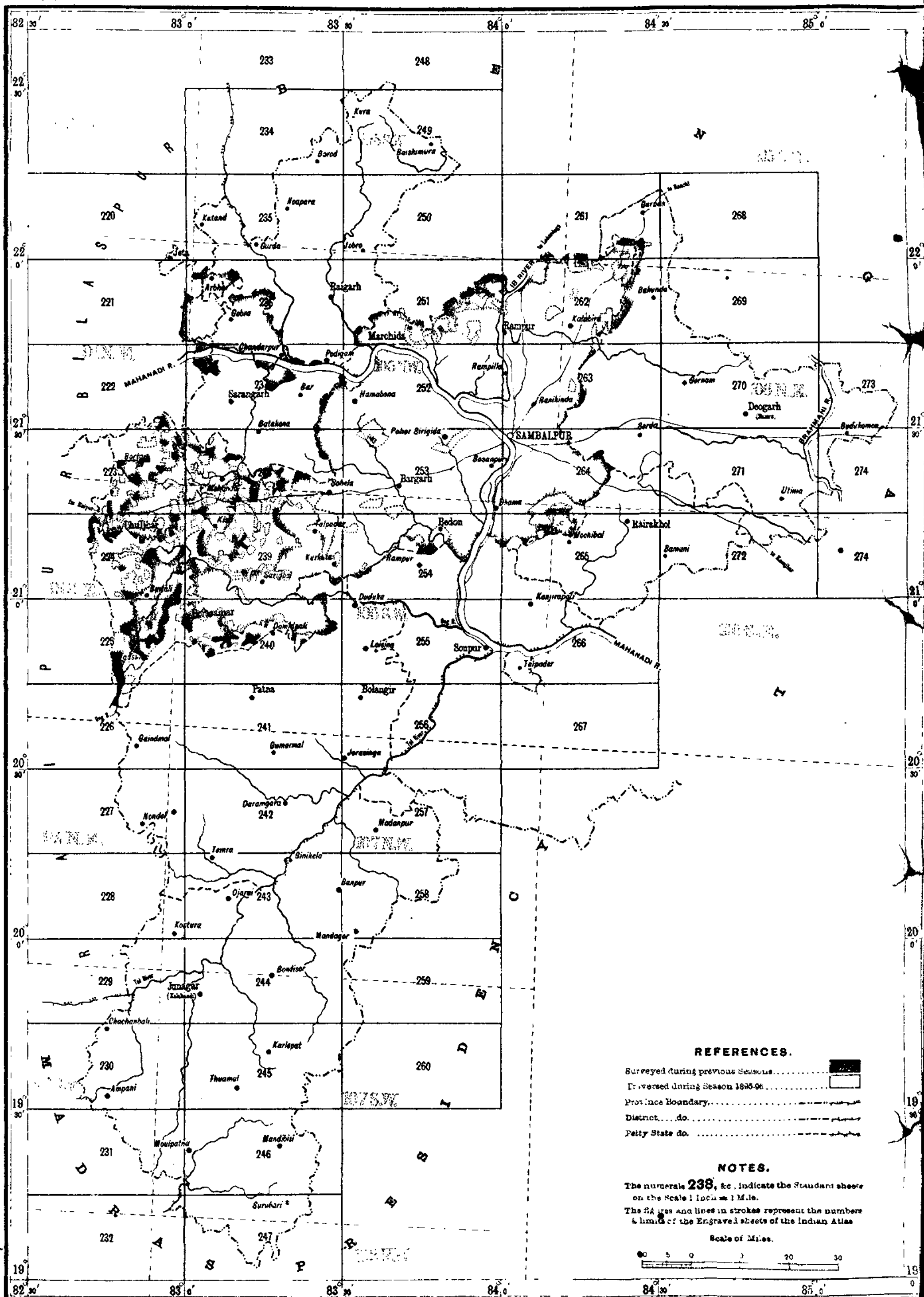
* Mr. Pemberton speaks in high terms of the services rendered by Mr. W. J. O'Sullivan, whose death, shortly after the close of the recess season, is much regretted. Messrs. Rae, Williams and Causley have all laboured with commendable zeal.

Of the native establishment the following are specially brought to notice :—Latifullah Khan, Dharonidhur Mukherjee, Sanat Kumar Chatterjee, Kanhya Lall, Mumtaz Ali and Meherban Ali.

CENTRAL PROVINCES SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT SAMBALPUR.

1895-96. No. 9 PARTY



Reg. No. 512, S. I. D.—Jan. 97—500

Photo. S. I. O., Calcutta

No. 326-S. 97.

CENTRAL PROVINCES SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT BILASPUR.

1895-96. | No. 9 PARTY.



No. 334-S. 97.

CENTRAL PROVINCES SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT RAIPUR.

1895-96. No. 9 PARTY.

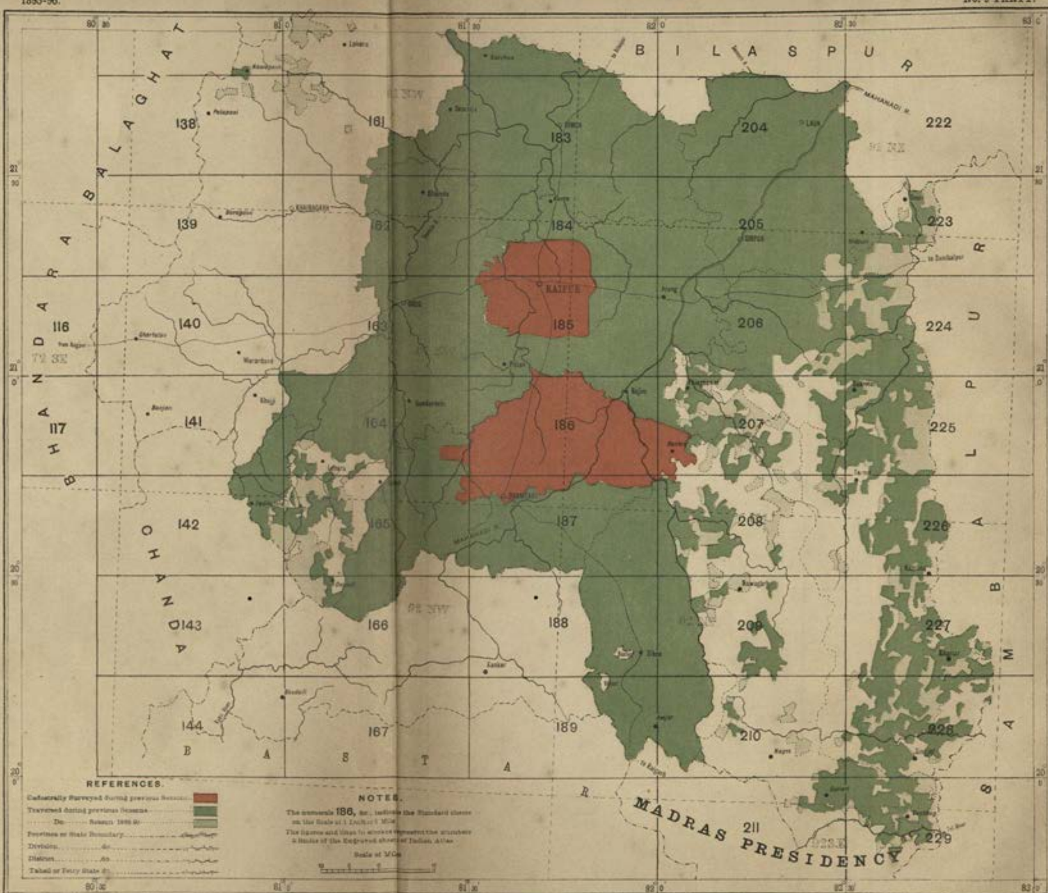


Photo., S. I. O., Calcutta.

No. 335-S. 97

CENTRAL PROVINCES SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT CHANDA.

1895-96. No. 9 PARTY.



Photo., S. I. O., Calcutta

No. 318-S. 97.

CENTRAL PROVINCES SURVEY.

INDEX TO THE TRAVERSE SURVEY in DISTRICTS SEONI & CHHINDWARA.

1895-96. No. 9 PARTY.

NARSINGHPUR

JUBBULPORE

MANDLA

HOSHANGABAD

BETUL

BERAR

NAGPUR

BHANDARA

BALAGHAT

SEONI

CHHINDWARA

67 68 69 70 71 72

87 88 89 90 91 92

109 110 111 112

35 36 37 38

50 51 52 53 54 55

LAKHNADON

NERBUDDA R.

55 S.E.

73 S.E.

REFERENCES.

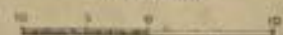
Traversed in previous Seasons	
Do. Season 1895-96	
Province or State Boundary	
District do.	
Tahsil do.	

NOTES.

The numerals **70**, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

The figures and lines in stroke represent the numbers and limits of the Engraved sheets of the Indian Atlas.

Scale of Miles.



No. 317-S. 97.

the various localities. The work was spread over 12,040 square miles, within which the 1,354 villages traversed covered an area of 3,330 square miles; these figures, compared with those of the previous season, *viz.*, 865 villages in an area of 1,892 square miles, show an increase by 489 villages and 1,438 square miles. This is owing to the Commissioner of Settlements and Agriculture, Central Provinces, agreeing to the proposal that the gaps left unsurveyed in previous years, should be traversed this season, and that the professional Survey should take credit for the area. The cost of the former was R39-2-2 and the latter R24-0-8, or a reduction of R15-1-6 per square mile. The rates have been calculated for the actual area of villages traversed without allowance for the extra work upon which they were based extending over an unusually large area.

419. The outturn of work for the season is shown in the following tabular statement :—

Districts.	Number of villages.	Number of sub-traverses.	Number of traverse stations.	Area in square miles.
Sambalpur	303	311	6,618	395·28
Bilaspur	410	614	9,465	1,109·91
Raipur	383	424	8,783	923·38
Chanda	103	104	1,821	506·93
Chhindwara	155	188	5,530	394·08
Totals	1,354	1,641	32,217	3,329·58

The total number of traverse stations fixed or embedded in the above districts were 17,260 dressed stones, in addition to 16,598 stones purchased and not used in seasons 1892-93-94 and 95, scattered over large areas, including rough stones and marks *in situ*, making a total of 33,858 permanent marks in an area of 4,260 square miles, scattered over 12,040 square miles. The total cost of the stones embedded amounted to R949-4-8; and their carriage cost, R1,309-14-2 and their erection R2,903-0-6, or R5,162-3-4 in all.

420. As usual, two chains were used throughout, one of 100 feet in length and the other of 66 feet; 140 azinuths were observed and the angular work was all that could be desired.

421. In cases where demarcation had not been made, the surveyors had to proceed along the line of boundary pointed out by the village headmen, and in cases of disputes references were made to the Deputy Commissioner.

422. The approximate positions of villages were marked on old *mujmilli* maps for the Sambalpur district by the Settlement Department and in cases where villages could not be traced references were made to the Deputy Commissioner. Topographical and *mujmilli* maps were used to locate village sites for the Bilaspur, Raipur and Chanda districts; the latter were faulty and in several instances the positions of village sites were out of position. The *mujmilli* maps received for Chhindwara were all that could be desired, and there was little or no difficulty in identifying the positions of the villages.

423. The work traversed this year was similar to that of the previous seasons, *i.e.*, the boundaries in many parts of the districts run over hills and undulating country. In the Chhindwara district the boundaries of all the villages run over very hilly and exceedingly difficult ground.

424. In the early part of the season there was a great deal of sickness and during the field season 15 men died from fever and cold, etc.

425. The camps and field surveyors were inspected and everything was done to meet the requirements of the local authorities in every way, and during the field season the 16-inch plots of 507 villages with 780 sub-traverse lines, or an area of 1,056·42 square miles, were submitted to the Settlement Officers.

426. During the recess months, index maps of the five districts were prepared for the Settlement Officers.

427. The party, having completed the traverse work in the Central Provinces where it has been employed for the past ten years, will be transferred

to the Madras Presidency for forest surveys, and during the ensuing season work will be undertaken in Perambalur forest reserve to the north of Trichinopoli and in the North Coimbatore hills.*

SINGHBHUM DISTRICT.

DETACHMENT.

Personnel.

Mr. J. P. Barker, Sub-Assistant Superintendent, 1st grade, in charge.
9 computers, etc.
9 surveyors and sub-surveyors.

428. The survey operations in the Kolhan Government estate, district Singhbhum, were in continuation of those of the previous season, and consisted of traverse survey only, as the cadastral survey is being undertaken by non-professional agency. The detachment was formed on the 1st January 1896, under the charge of Mr. J. P. Barker, but considerable delay was experienced in getting the establishment together, and it was not till the 22nd January that field work commenced.

The detachment was under the administrative supervision of Captain R. T. Crichton, S. C., Superintendent of Settlement Surveys, Bengal.

429. The entire area of the Kolhan estate was originally estimated to be about 1,423 square miles, of which 1,175 square miles were traversed during 1894-95, thus leaving 248 square miles as the programme for the season under report, but this must have been incorrect, as, although the traversing of the estate has been accomplished, the outturn of the season was only 229 square miles.

430. The area traversed is comprised in two subsidiary circuits and five compact blocks of villages; also a number of isolated villages at considerable distances apart. The total number of villages traversed is 172. The theodolite was set up 8,319 times and all stations were marked by stones locally picked up. The angular work was checked by 68 observations for azimuth. The cost-rate per square mile of traverse survey was R43·8.

431. The usual precautions for ensuring correct chaining, such as the employment of two chains of different lengths, were taken, and in hilly country angles of elevation and depression were observed in order to reduce the chaining to its horizontal equivalents. The total number of miles of new chaining was 903. The small amount of correction to the chaining necessary in order to close each polygon, and for the comparison of the direct distances between G. T. stations with the same distances by the traverse survey, show that, considering the nature of the country, the work has been well done.

432. No demarcation was done before the commencement of operations, and although the line-clearing squads were all at work by the 8th January, they were soon overtaken by the traverse surveyors owing to the time taken up in clearing heavy jungle.

433. All the 16-inch plots of the 172 villages in 298 sheets have been handed over to the Settlement Department. The records of both seasons are completed, and, after the final examination and binding up of the volumes, will be despatched to the Calcutta office during October 1896.

434. The difficulties experienced in this survey were considerable. The country was most difficult to work in, and during March and April extremely unhealthy. During the previous season, November and December were reported to be the unhealthy months, and it was therefore decided not to commence work in the season under report until January 1896, but great difficulty was experienced in obtaining suitable establishments in the middle of the field season, and it was owing to the above causes that the field work, which it was hoped would be finished by the end of March, was not completed till the end of April.†

* The officer in charge reports that Mr. Dowman performed his duties to his entire satisfaction, and he also speaks well of Messrs. Peters, George, and Donaghey.

Of the native establishment the following are selected for special mention :—Murli Manohar, Hilaludin, Dewa Singh, Birbhan II, Ganpat Rai, Abdul Gafur, Wali Mahomed, Alla Bux, Wajidullah and Badri Singh, sub-surveyors; Lal Mohan, Upendranath Mukerjee, Jogendra Nath Ghosal, Manohar Daji, Gopal Sitaram, Kesho Vaijnath, Vishnu, Sitaram and Brij Behari Lal, computers; Karim Bux, draftsman; and Taraprosono Roy, writer.

† Captain Crichton reports that Mr. J. P. Barker, who held charge of the detachment, deserves considerable credit for the manner in which he managed his detachment. Mr. Barker reports well of the work done by his assistants.

BENGAL SURVEY.

1895-96. INDEX TO THE TRAVERSE SURVEY, KOLHAN GOVT. ESTATE, DIST. SINGBHUM. DETACHMENT.

REFERENCES.

Traversed during 1894-95

Traversed Season 1895-96

Province or State Boundary

District ... do.

Political State ... do.

Thana ... do.

Harda ... Kotagara ... Saraikela ... Chakardharpur ... Kharsawan ... Borkatar ... Saraikela ... Subarnrakha R. ... Amchara ... Haldipukar ... Ghatsila ... Chakutia ... CHAIBASSA ... Noagaon ... Bomoro ... Bhairagora ... to Midnapore ... Subarnrakha R. ... Dhipa ... Koel R. ... Karo R. ... Tiriposi ... Baljodi ... Nuagaon ... Kolhan ... Bengal Nagpur Railway

125 126 127 128 156 157 158 159 160 185 186 187 188 214 215 216

GARHJAT STATES ... ORISSA TRIBUTARY STATES ... MANBHUM ... MIDNAPORE

NOTES.

The numerals 187, &c., indicate the Standard sheets on the Scale 1 Inch = 1 Mile

The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas.

Scale of Miles.



No. 302-S. 97.

BENGAL SURVEY.

1895-96. INDEX TO THE CADASTRAL SURVEY OF KHALSA VILLAGES IN DIST. PALAMAU. DETACHMENT.



Reg No. 459, S. I. D.—Jan. 97.—1,050.

Photo., S. I. O., Calcutta.

No. 303-S. 97.

PALAMAU DISTRICT.

DETACHMENT.

Personnel.

Mr. L. F. Berkeley, Extra Assistant Superintendent, 6th grade, in charge.
11 computers, etc.
16 surveyors and sub-surveyors.

435. Under orders from the Government of Bengal, such portions of the external boundaries of the *khalsa mauzas* of the Palamau Government Estate as had not been surveyed in the course of the survey of cultivated blocks accomplished in seasons 1893-95 were laid down on the ground in accordance with the revenue survey maps of 1863-65. This work was undertaken by a small detachment under the immediate charge of Mr. L. F. Berkeley, who had been in charge of the cadastral operations in this district for the past two seasons. The detachment was under the administrative charge of Captain R. T. Crichton, S. C., Superintendent of Settlement Surveys, Bengal.

436. In order to avoid unnecessary clearing of lines through thick jungle, the procedure was somewhat complicated, and may be described shortly as follows:—The traverse surveyor was supplied with a plot on the 4-inch scale, showing all theodolite stations which had been fixed during the cadastral survey. On this plot the approximate position of the old revenue survey boundary was shown in pencil. The traverse surveyor then laid down this pencil boundary on the ground by means of the plane-table and chain, his lines being cleared of jungle as he proceeded. He then surveyed these lines with the theodolite, and at the same time connected with all *pucca* tri-junction marks which had been omitted from the cadastral survey. On the completion of the traverse of each village his field book was sent to the Survey Office. These traverses were accurately plotted in office in their true position and compared with the old revenue survey boundary, and the measurements of all offsets from this preliminary boundary, necessary for fixing the bends of the true revenue survey boundary, were entered on the plot, which was returned to the surveyor, who then laid down the boundary on the ground.

437. The area traversed was 141 square miles, containing 158 portions of villages. The linear miles of chaining amounted to 392, and 29 observations for azimuth were taken. The theodolite was set up 4,325 times, and all these stations were permanently marked by large stones.

438. There are 81 field sheets on the 4-inch scale in the season's work. Of these, 57 sheets contain fair maps of 184 villages, of which portions of the boundaries had not been surveyed in the course of the cadastral survey, and the remaining 24 sheets contain only villages which were completed in boundary survey during the cadastral operations and are intended merely to serve as indexes to the traverse of cultivation. Traces of the above-mentioned 57 sheets on the 4-inch scale are being prepared for the Settlement Officer and will be supplied him during October 1896. Topographical details, such as streams, roads, etc., have been entered on the traces by reduction from the 16-inch maps.

439. The cost-rates of the season's work are as follows:—For traverse survey, R54; for stone-embedding, R7·2; for demarcation, R38, and for 4-inch mapping, R10·8 per square mile.

440. In order to aid the Settlement Officer, the demarcation of two villages, in accordance with the settlement of disputes, was undertaken. Also 330 fields, with an area of 647 acres of cultivation, which was either new or had been concealed at the time of the cadastral survey, were surveyed on the 16-inch scale during the year under report. The demarcation of eight protected forest blocks was also traversed for the Settlement Officer. Fresh traces of 309 villages on the 16-inch scale, surveyed during previous seasons, were also prepared and sent to him. None of the above details of work were included in the season's programme.

441. At the request of the Deputy Commissioner, a survey of Daltonganj town, on the 64-inch scale, was undertaken, and a map supplied to him at a cost of R196. The area surveyed was 109 acres; it had been previously surveyed on the 16-inch scale, but the small-scale map did not admit of partitions being clearly marked off on it.

442. Field work was commenced on the 10th November 1895 and the detachment proceeded to recess quarters on the 12th June 1896. The late date of closing field work was due to the amount of line-clearing that was necessary.

443. Mr. Berkeley inspected and tested the demarcation on the spot of 124 of the villages surveyed. The demarcation in the remaining 34 villages was checked by independent *partals*. The detachment was inspected by Captain Crichton in February 1896, who was satisfied that the work was being done in a careful manner.*

GEODETIC.

LONGITUDE OPERATIONS.

NOS. 22 AND 23 PARTIES, ASTRONOMICAL.

444. In the summer of 1894 it was decided to despatch the two astronomical parties under Captains Burrard and Lenox-Conyingham to Baluchistan and Persia with the object of determining telegraphically the longitude of points on the Makran Coast and the Persian Gulf. An opportunity was thus presented of obtaining *viâ* Teheran a new and refined determination of the longitude of Madras, a determination that had for years been considered desirable. This opportunity was taken, and the officers deputed for the work were ordered to extend their operations through Persia and Europe to Greenwich.

Personnel.

No. 22 Party (Astronomical).

Captain S. G. Burrard, R.E., Deputy Superintendent, 1st grade, in charge.
Munshi Aulad Hussein, Sub-Assistant Superintendent, 2nd grade.

No. 23 Party (Astronomical).

Captain G. P. Lenox-Conyngham, R.E., Deputy Superintendent, 2nd grade, in charge.
Babu Hanuman Prasad, Computer.

445. The instrumental equipment consisted of two complete sets of instruments, each set comprising a transit telescope, a chronograph, an astronomical clock and a break circuit chronometer. The chronometers were included as a reserve to fall back upon in the event of the clocks receiving damage during the expedition. The observers found all their instruments highly satisfactory, and have returned them to Dehra in as good order as when they started.

446. As the difference of longitude between Madras and Karachi had been already accurately determined, it was only necessary to commence at Karachi and determine its difference from Greenwich. The original plan of operations included observing-stations at Odessa, Emden and Lowestoft, but this was afterwards modified, and the following arcs were those actually measured :—

Karachi-Bushire.
Teheran-Bushire.
Teheran-Potsdam.
Potsdam-Greenwich.

As the observers had had no experience of working with submarine cables, Colonel Gore, R.E., Superintendent of Trigonometrical Surveys, ordered them to introduce a check on the determination of the Karachi-Bushire arc by the insertion of Jask and the measurement of the Karachi-Jask and Jask-Bushire arcs in addition to the direct determination. They were also ordered to determine the longitude of Charbar for topographical purposes.

447. The measurement of an experimental arc in Dehra Dun was the first operation undertaken. One telescope was set up a few feet south of the other, so that there was no difference in longitude between them, and a complete set of longitude observations, including those for personal equation, were taken. All telegraphic connections were made as on regular longitude work, the comparative shortness of the line wire being the only difference. The resulting difference of longitude was $0^{s}{\cdot}017$, and this error was considered sufficiently small to justify the commencement of operations between Karachi and Greenwich.

448. On November 26th, 1894, the two parties sailed from Karachi, and on December 9th the observations of the Jask-Bushire arc were commenced. The

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* Captain Crichton reports that Mr. L. F. Berkeley, who held charge of the detachment, has done very well in a difficult position. The subordinates are also said to have given satisfaction.

weather was fine, no difficulties were experienced, and the measurement was satisfactorily completed on December 14th. Captain Burrard then observed for latitude and azimuth at Jask, and on December 27th, having returned to Karachi, he was ready to start the Karachi-Bushire arc. This arc had to be prematurely closed on January 2nd to enable Captain Conyingham to travel by the Government Telegraph Steamer *Patrick Stewart*, which was proceeding from Bushire to Charbar.

449. Captain Conyngham arrived at Charbar on January 10th, and then observed the latitude, the azimuth of a fixed mark, and the telegraphic difference of longitude from Karachi. He then proceeded to Jask, and from January 21st to February 3rd observations were taken for the Karachi-Jask arc. The two observers then met at Karachi and observed for personal equation. Both speak very highly of the great assistance which they received from Mr. Possmann, the Director of the Persian Gulf Telegraphs, and of the zealous co-operation of the members of the cable staff.

450. On March 14th Captains Burrard and Lenox-Conyngham sailed for England. Their first duties on arrival were to have their clocks repaired and an alteration made to one of the telescopes. When this work had been executed, they commenced the measurement of the Potsdam-Greenwich arc. Professor Christie, the Astronomer Royal, at Greenwich, and Professor Helmert at Potsdam, showed a cordial interest in the work: they not only gave the Indian observers sites for their stations on the central meridians, but placed excellent observatories at their disposal and allowed them the use of the standard clocks and any other instruments that they required. The Government of India is much indebted to these two distinguished astronomers for the valuable aid that they rendered for the furtherance of this determination of longitude. Mr. Preece, C.B., F.R.S., the Engineer-in-Chief of the General Post Office in London, allowed Captains Burrard and Conyngham the free use of a land line from Greenwich to Lowestoft and of a cable from Lowestoft to Emden, and he also obtained for them from the German Government the loan of a wire connecting Emden and Potsdam. Dr. Von Stephan, the German Postmaster General, gave orders that every assistance should be rendered at Potsdam and attached an officer, Herr, Post Inspector Arpurth, to the Potsdam Observatory to superintend the telegraphic arrangements during the measurement of the arc: he also, in conjunction with Mr. Preece, took steps to enable the two observatories at Greenwich and Potsdam to be directly connected without any intermediate translation.

In the last week of May 1895, observations were made for personal equation at Greenwich, and on June 17th the Potsdam-Greenwich arc was commenced, Captain Conyngham being at Potsdam and Captain Burrard at Greenwich. In the course of this arc the late General Walker, C.B., R.E., F.R.S., under whom these operations were commenced in India, paid a visit to Captain Burrard's observatory at Greenwich and showed a characteristic interest in the scheme. On July 3rd the two observers interchanged stations, and in their new positions recommenced work on July 11th. On July 26th they completed the measurement, and five days later met again at Greenwich to re-observe their personal equation.

451. Captain Conyngham now moved to Teheran *viâ* Odessa, Batoum and Baku. At Odessa he was met by Babu Hanuman Prasad and four *khalasis*, who had been despatched from Dehra Dun by Colonel Gore. At Teheran the longitude station was built in the grounds of the British Legation, where Sir Mortimer Durand allowed the pillars to be erected. A line wire was placed at the disposal of the observers by Mr. Andrews, the Managing Director of the Indo-European Telegraph Company; this wire connected Teheran with Berlin, and the German Government allowed a wire between Berlin and Potsdam to be used for the work. Owing to the extreme length of the wire and to the paucity of available cells at Teheran, and to the desire of the observers to work with only one translating relay, the current was so weak that the signals from the observatories were obliterated by induction-currents from neighbouring wires: to obviate this the German Telegraph authorities with characteristic liberality were good enough to grant the valuable concession, that all telegraph traffic on the thirty-two wires running parallel to the wire, which the observers were using, between Berlin, Warsaw, and Odessa, should be stopped during the interchange of longitude signals, and Mr. Andrews gave orders that his second wire should

be kept silent whenever the observatories were communicating on the line that he had set apart for their connection. At first the observers had decided to take two clock comparisons per night, but when they saw the great delays to traffic caused by the stoppage of so many wires in the midst of populous Europe, they thought it incumbent on them to take as little advantage as possible of the generous concessions extended to them, and to cut down their telegraphic communication to a minimum, and they therefore eventually exchanged their clock signals but once in a night.

On October 31st work was commenced on the Teheran-Potsdam Arc, and was continued for ten days with varying success, the observations being greatly interfered with by clouds. On November 9th the telegraph lines were carried away by floods in the Caucasus, and were only restored on November 21st. Work was then interrupted by snow storms at Potsdam and clouds at Teheran, and the measurement was not completed till December 15th.

452. Captain Burrard had then to move from Germany to the Persian Gulf, and during his journey Captain Conyngham occupied himself in connecting his longitude station by triangulation with that of General Stebnitzki and in fixing the position of his observatory with reference to permanent objects in the vicinity, so as to ensure its future identification. On February 27th Captain Burrard arrived at Bushire, and on March 4th the Teheran-Bushire arc was commenced. Twelve days later the measurement was satisfactorily completed, and both observers returned to India.

On May 18th they met at Dehra, and there on four successive nights observed a final value of personal equation. This closed the work of the expedition and completed the re-determination of the longitude of Madras.

453. The resulting values of the six measurement which were made are as follows:—

	h.	m.	s.
Karachi-Jask	0	36	59·697
Jask-Bushire	0	27	45·057
Karachi-Bushire	1	4	44·812
Teheran-Bushire	0	2	21·438
Teheran-Potsdam	2	33	24·223
Potsdam-Greenwich	0	52	15·929

454. The first three of these arcs form a circuit, and their closing error may be deduced thus:—

	h.	m.	s.
Karachi-Jask	0	36	59·697
Jask-Bushire	0	27	45·057
Sum	1	4	44·754
Karachi-Bushire	1	4	44·812
Closing error			0·058

The smallness of this closing error is satisfactory evidence of the high accuracy of the work.

455. The value to be finally adopted for the difference of longitude between Karachi and Bushire is obtained as follows:—

	h.	m.	s.
Sum of the two Jask arcs	1	4	44·754
Karachi-Bushire, as observed	1	4	44·812
Mean value, regard being paid to relative weight	1	4	44·787

The longitude of Madras can now be calculated as follows:—

		h.	m.	s.
Potsdam-Greenwich	+	0	52	15·929
Teheran-Potsdam	+	2	33	24·223
Teheran-Bushire	—	0	2	21·438
Karachi-Bushire	+	1	4	44·787
Bombay-Karachi	+	0	23	12·196
Bolarum-Bombay	+	0	22	48·801
Madras-Bolarum	+	0	6	54·615
Longitude of Madras		5	20	59·113

This value is $0^s.308$ less than the value $5^h\ 20^m\ 59^s.421$, which has hitherto been regarded as the most accurate value available. The quantity $0^s.308$ is equal to $4''.62$, and represents in linear measurement about 150 yards.

The last calculation of the error in longitude of the Indian triangulation was made in 1893, and by that investigation the error was given at $+2'\ 22''.92$: according to the recent determination, just completed, this error is shown to be $+2'\ 27''.54$.

456. The discrepancy of $0^s.308$ or $4''.62$, small as it may appear to be, is by no means a quantity that can be disregarded in scientific surveying. Two independent telegraphic determinations, if executed with every modern requirement, would not be expected to differ by such a large amount, and its appearance now sufficiently demonstrates the necessity of the recent re-measurement. In 1893, when the question was raised as to whether the time had come to introduce change in the longitude of the Indian survey, it was held that the value then accepted as the best had not been determined with such requirements or precautions as to justify any alteration. The results of the recent expedition show the wisdom of this decision, for no two opinions can exist as to the inexpedience of changing the fundamental longitude of British India and South-Eastern Asia, when the new value to be adopted might be in error by nearly 5″. The magnitude of errors can only be discussed comparatively, and what would be regarded as a large error in one branch of surveying might be neglected as unimportant in another, but it will be readily conceded that the initial elements of the Great Trigonometrical Survey of India should be known to a higher degree of accuracy than 5″.

457. It was estimated that the cost of the expedition, excluding the salaries of the observers, but including all their travelling and contingent expenses, the transport of the instruments and the pay of the temporary assistants in Europe, would amount to R49,000, but the actual cost proved to be a little over R36,000, a very satisfactory result.

458. The very successful conclusion of these delicate but arduous operations is due very largely to the unremitting care and attention bestowed upon them by Captains Burrard and Lenox-Conyngham. To those unacquainted with such operations, it is difficult to conceive the strain and anxiety entailed by the work and by the fact that so many causes which are not under the observer's control may interfere at any moment to vitiate the results so laboriously striven for. Both these officers are to be heartily congratulated on the satisfactory results achieved.

TIDAL AND LEVELLING OPERATIONS.

No. 25 Party.

459. The direction of these operations was in the hands of Colonel J. Hill, R.E. (with the exception of the first five days of the year), until he reverted to the Military Department, with effect from the 25th December 1895, having attained the age of 55 years. Lieutenant Morice, R.E., was then placed in charge; he was promoted to the rank of Captain on the 12th August 1896, and took one month's privilege leave from the 14th August. Mr. G. Belcham held charge during his absence.

Personnel.

Colonel J. Hill, R.E., Superintendent, 2nd grade, in charge up to 25th December 1895.
Captain C. C. D. Morice, R.E., Officiating Deputy Superintendent, 2nd grade, in charge from 25th December 1895 up to 14th August and from 15th September 1896.
Mr. G. Belcham, Extra Assistant Superintendent, 2nd grade, in charge from 14th August up to 14th September 1896.
" E. J. Connor, Extra Assistant Superintendent, 4th grade.
" J. Bond, Extra Assistant Superintendent, 4th grade.

Surveyors, etc.

Dhondu Vinayek, Vinayek Narayen, N. V. Apte, 2 native mechanics, 14 recorders and computers.

Tidal Operations.

460. The automatic recording of the tidal curves, their reduction and the publication of the predicted times and heights of high and low water have been continued, and tidal observations by means of self-registering gauges have been

carried on during the year at thirteen stations, *viz.*, *Aden*, Maskat, Bushire, *Karachi*, *Apollo Bandar* (*Bombay*), Prince's Dock (Bombay), Minicoy, Trincomalee, *Madras*, *Kidderpore*, Diamond Island, *Rangoon* and *Port Blair*. The six tidal stations whose names are not italicised are minor stations, where observations, as a rule, are taken for five years only. The others are permanent stations, where the minimum period of observations lasts for 19 years, and where observations should be continued until the whole scheme of tidal operations has been completed. In addition to the observations taken at the stations enumerated above, personal tidal observations to graduated staves were taken daily, with the object of comparing the actual heights and times of high and low water with those predicted in the tide-tables at the following tidal stations, at all of which the tidal observatories are closed :—Bhavnagar, Cochin, Tuticorin, Colombo, Chittagong, Akyab, Moulmein.

461. At the island of Minicoy the tidal observatory was closed on the 19th January 1896, and at Trincomalee on the 9th March 1896, five years' observations having been completed at those stations.

462. A new tidal observatory was erected at Suez during the year, and will receive its instruments in due course next field season; and preliminary arrangements, and enquiries, including reconnaissance of the coast and foreshore and selection of site and type of design, have been made with a view to starting three other new tidal observatories, namely, Perim, Port Albert Victor and Porbandar. In addition to this a careful examination of Mangalore was made; the conditions are, however, so unfavourable, that the place is pronounced unsuitable for a tidal station. An examination was also made of the Isthmus of Kra, between Burma and the Malay Peninsula, just above Lat. 10° N., with a view to finding suitable sites for tidal stations on each side, and a practicable route for spirit-levelling to connect the two and compare the sea-levels, but no such route could be found. The only site at all physically suited for a tidal observatory on the western side, namely Victoria Point jetty, cannot be recommended owing to the difficulty of communication with it, and the eastern side, though approached within 30 miles, could not be examined owing to the local political authorities not having received instructions to assist the reconnaissance. Consequently the scheme has been abandoned for the present, but a similar project further south, in or near the States under British protection, may possibly be undertaken in about Lat. 6° or 7° N. Acheen and Bangkok have been left out of the programme of future operations; the latter because a tidal observatory there, however valuable locally, would be useless to this department owing to its situation, 30 miles from Menam, irregularities due to freshets and the network of tidal canals, etc.; and the former because it has been decided that the results of the observations being made locally by the Dutch Government will suffice for this department.

463. Thus since the resumption of systematic tidal operations in 1877, observations have been taken at 34 tidal stations, of which 23 have been closed, on completion of their registrations, and 11 are now in operation.

464. During the survey year 1896-97 no tidal observatories will be closed. The new tidal observatory at Suez will receive its instruments and observations will be started. If the proposed site at Perim be proved to be suitable by preliminary observations, soundings and trials of the bottom, and if the arrangements can be made for starting the operations and for maintenance of the clerks, Perim observatory will be established. Porbandar observatory will also be built and the operations started, subject to similar preliminary arrangements resulting in the adoption of the proposed site. At Port Albert Victor, where the observatory is to occupy the lower portion of a lighthouse, to be built by the State Engineer of Bhavnagar, arrangements can be made for starting the instruments as soon as the observatory is reported to be built.

465. All the tidal observatories have been inspected. An account of the working of each observatory will be found in the detailed report on the tidal operations which has been printed in a separate pamphlet entitled " Report on the Tidal and Levelling Operations for the year 1895-96," where also certain circumstances deserving special notice are reported at Aden, Maskat, Bushire, Karachi, Apollo Bandar (Bombay), Prince's Dock (Bombay), Kidderpore and Port Blair. No serious interruption of tidal observations occurred at any of the tidal stations. At Kidderpore there were minor defects in the tidal registrations, due to the

necessity of changing the clerk owing to illness, and inexperience of the men who successively took over his duties ; but it has not been found necessary to reject the imperfect tidal diagrams. At Port Blair, owing to the tide-gauge clock getting out of order, and attempts to restore it to good order failing, there is a break in the automatic registrations from the 3rd August to the 21st September, but with the help of the predictions and the graduated staff readings taken, the missing curves can be interpolated and the interruption practically matters very little.

466. The tidal operations of the year may be pronounced very successful—a result due to a great extent to the assistance received from local officials, whose kind co-operation has been acknowledged by Captain Morice. Special thanks are due to Murray Bey, Captain of H. H. S. *Aida*, Suez, for assistance regarding the new observatory there; to Captain J. C. Capper, R.E., Executive Engineer, Military Works Department, Aden, for similar assistance and for designs for Perim; to Mr. B. McMullen, Superintendent of Telegraphs at Reshire, for his active co-operation in keeping the Bushire tidal observatory in working order ; to Mr. W. W. Squire, M. Inst. C.E., Engineer, Port Trust, Bombay, for his prompt execution of necessary repairs to the Bombay observatories, and for promised assistance in preparing the observatory, etc., for Perim; to Mr. J. J. B. Benson, C.E., State Engineer of Porbandar, for co-operation n selection of the site for a tidal observatory there, for perfecting the design and for preliminary work necessitated by the nature of the coast ; to Captain Petley, R.N., Deputy Conservator of the Port of Calcutta, for his endeavours to keep the Kidderpore observations in progress at the time of the difficulty about clerks ; and to Captain A. Channer, R.N., Superintendent, Ceylon and Minicoy Imperial Light Service, for his invaluable help in allowing his vessel to be our main means of communication with the Island of Minicoy, throughout the five years' tidal observations there, and for a great deal of assistance in many ways.

467. As regards the auxiliary meteorogical observations taken at the tidal stations, a system of comparison of the instruments working at the stations, with portable instruments taken from Poona and tested there before and after the field season, has been carried out, as far as practicable, at all the inspections of the tidal stations. Full details are given in the report published separately, but the result of the new light thus thrown upon the meteorological observations is, that they are considered to be of too approximate a character to allow of their being treated by precise analysis ; and it is suggested that the aneroid barometers at present in general use be discarded, owing to their being of a pattern which does not give reliable records.

468. The reduction of the tidal observations has been carried on steadily during the year. Observations for one year at thirteen tidal stations, and for two years at one station (Porbandar) have been reduced. The tabulated values of the constants so obtained will be found in the separate report. The computations for each tidal observatory commence now, as a rule, on January 1st. The observations at Porbandar that have been reduced this year were taken during twenty months by the State Engineer of Porbandar by personal observations of an indicator carried by a float in an observatory he had constructed. They were somewhat frequently interrupted, but were adapted to the method of Harmonic analysis by special treatment particularised in the detailed report.

In addition to the constants mentioned above, constants to be employed in setting the Tide-predictor were calculated for the year 1897, and sent to Mr. Roberts of the Nautical Almanac Office ready for use: he was also furnished with tabulated comparisons for the year 1895, between the predicted times and heights of high and low-water at 19 stations, published in the Tide-Tables for that year, and their values obtained by actual measurement, thus giving him in a convenient form information adapted to assist him in improving subsequent predictions, especially at the three principal riverain ports—Kidderpore, Rangoon and Moulmein.

469. The Tide-Tables again arrived from London over a month too late to admit of their being distributed to the several ports before the beginning of the year 1896, for which they predicted the tides. Colonel Hill's suggestion that the intervention of the India Store Department be dispensed with, and Mr. Roberts be authorised to forward the Tide-Tables direct to this office, is again advanced.

470. The Tide-Tables for 1897 will contain predictions for 37 tidal stations, including the first issues of tide-tables for Porbandar and for Diamond Island (Burma).

471. The usual tables showing the results of the predictions are given for the year 1895 in the separate report, and may be summarised as follows:—

Percentage of time predictions within fifteen minutes of actuals.

			High water per cent.	Low water per cent.
Open coast stations	10 at which predictions were tested by	S.R. tide-gauge	66	63
	5 " " " "	tide-pole	80	88
Riverain stations	2 " " " "	S.R. tide-gauge	59	55
	2 " " " "	tide-pole	68	61

Percentage of height predictions within eight inches of actuals.

			High water per cent.	Low water per cent.
Open coast stations	10 at which predictions were tested by	S.R. tide-gauge	96	93
	5 " " " "	tide-pole	94	87
Riverain stations	2 " " " "	S.R. tide-gauge	74	47
	2 " " " "	tide-pole	59	64

Percentage of height predictions agreeing within one-tenth of mean range at springs.

			High water per cent.	Low water per cent.
Open coast stations	10 at which predictions were tested by	S.R. tide-gauge	91	89
	5 " " " "	tide-pole	85	92
Riverain stations	2 " " " "	S.R. tide-gauge	94	84
	2 " " " "	tide-pole	91	85

In this summary, as explained in the detailed report, the tests by self-registering tide-gauges are the more reliable, especially with regard to time. Subject to this consideration the predictions for time, although not equal to those for height, are undoubtedly very good, and the figures as a whole show a high standard of accuracy.

SPIRIT-LEVELLING OPERATIONS.

472. The regular levelling operations were carried out by Mr. J. Bond. His instructions were to carry a double line of levels from Raipur, on the direct line between Bombay and False Point, southwards *viâ* Dhamtari and Jeypore to Vizianagram, joining on to the levelling near Vizagapatam tidal station, which had been carried along the East Coast Railway during the previous field season, and to connect with as many as possible of the Great Trigonometrical Survey stations of the Bilaspur Meridional Series; thus completing the first instalment of the line between Vizagapatam and Allahabad. The levelling was carried from Raipur along the new main road *viâ* Abhankur and Kurúd to Dhamtari; thence across the Mahánadi river at Achota Ferry, and along the rough cart-track *viâ* Kukrel, Dokál, Gatasili, Síháwa and Borai to the frontier of the Jeypore State; thence along the Agency road *viâ* Umarkot and Naurangapur to Jeypore, and finally over the Jubilee ghát and along the Itikivalasa-Koráput road to Potangi, where work had to be closed for the season owing to the entire party being incapacitated by sickness, leaving about 60 miles of the season's programme unfinished, excluding branch lines.

473. The work was carried over the very rough and hilly country, covered with jungle, lying between Dhamtari and the Jeypore frontier, over the series of low undulating hills which rise and fall with the regularity of huge waves, and over the mountains of the Eastern Gháts in the Agency tracts of the Vizagapatam district. This country is extremely wild and sparsely inhabited, and intersected with rivers, streams and numerous water-courses; the most important rivers being the Mahánadi, Tel and Indrávati.

474. The total rises and falls of the country levelled over amounted to 19,056 feet, and the total outturn to 278·5 miles of double levelling, in the course of which the instruments were set up at 4,149 stations, and the heights of 24 embedded bench-marks, 162 ordinary or inscribed bench-marks and

4 stations of the Great Trigonometrical Survey were determined. In the wild jungly tracts through which the work passed, there are no objects of a permanent nature to connect as bench-marks except rocks *in situ*, which were occasionally met with; consequently the number of ordinary or inscribed bench-marks is fewer than usual for the distance traversed. The outturn is a good one, and creditable to Mr. Bond, who kept the work progressing in spite of much sickness in his detachment and an unusually difficult line of country. Credit is also due to Mr. Bond for the arrangements he made, when the detachment was incapacitated by fever towards the end of the field season.

475. During next field season, the levelling operations will be resumed at Potangi, where they had to be closed on account of sickness, and continued to join the levelling executed in 1894-95 near the Vizagapatam tidal station, thus completing the first instalment of the line between Vizagapatam and Allahabad. In connection with this work the Vizagapatam base will be connected. On completion of this work the detachment will proceed to Bilaspur, on the direct line from Bombay to False Point, and continue the line between Vizagapatam and Allahabad by starting from Bilaspur and proceeding along the Bengal-Nagpur Railway to Katni, and thence *viâ* the East Indian Railway to Allahabad.

476. In addition to the regular departmental work of the tidal and levelling party, a very considerable amount of extra work had to be undertaken in order to furnish other departments, Local Governments and officials, with information applied for by them.

477. The office of this party was visited by the Surveyor General in September 1896. The annual inspection by the Superintendent of Trigonometrical Surveys will be carried out early in October.*

* Captain Morice reports most favourably of Messrs. Belcham and Connor and Surveyor Dhondu Vinayek in the tidal division, and of Mr. Bond and Surveyor Vinayek Narayen in the levelling division. The staff of native mechanics, sub-surveyors, and computers are reported to have worked well and given satisfaction.

TABULAR STATEMENTS.

Summary of the outturn of work of the

Scale of Survey.	Number of Party.	Locale of field operations.	Triangulation.									Spirit-levelling operations.		
			Instrument used. Diameter in inches.	Area in square miles.	Square miles to each point trigonometrically fixed.	Square miles to each height.	Secondary. Stations fixed.	Secondary. Triangular error in seconds.	Secondary. Error per mile in feet.	Tertiary. Intersected points.	Tertiary. Error per mile in feet.	Miles levelled over.	Permanent bench-mark stones embedded.	Trigonometrical stations connected with.
Inches to a mile. 105·6 & 52·8	7	Rangoon Town	5 & 6	...	...	...	19	8	0·2	23	0·4	...	156	...
66	12	Karachi Town	...	...	...	...	...	...	...	...	...	...	...	...
64	4 & 5	Bettiah Town	...	...	...	...	...	...	...	...	...	...	...	...
	Det.	Daltonganj Town	...	...	...	...	...	...	...	...	...	...	...	...
		Totals	...	...	...	...	...	...	...	...	...	...	...	...
32	4 & 5	Gaya	...	...	...	...	...	...	...	...	...	...	...	...
		Muzaffarpur	...	...	...	...	...	...	...	...	...	...	...	...
		Totals	...	...	...	...	...	...	...	...	...	...	...	...
27	4 & 5	Muzaffarpur	...	...	...	...	...	...	...	...	...	...	...	...
16	2	Shahjahanpur	...	...	...	...	...	...	...	...	...	...	...	...
		Kheri	...	...	...	...	...	...	...	...	...	...	...	...
	3	Shwebo	...	...	...	...	...	...	...	...	...	...	...	...
		Yamethin	...	...	...	...	...	...	...	...	...	...	...	...
		Katha	...	...	...	...	...	...	...	...	...	...	...	...
		Upper Chindwin	...	...	...	...	...	...	...	...	...	...	...	...
		Myingyan	...	...	...	...	...	...	...	...	...	...	...	...
	4 & 5	Saran	...	...	...	...	...	...	...	...	...	...	...	...
		Champaran	...	...	...	...	...	...	...	...	...	...	...	...
		Muzaffarpur	...	...	...	...	...	...	...	...	...	...	...	...
		Darbhanga	...	...	...	...	...	...	...	...	...	...	...	...
		Gaya	...	...	...	...	...	...	...	...	...	...	...	...
		Patna	...	...	...	...	...	...	...	...	...	...	...	...
		Monghyr	...	...	...	...	...	...	...	...	...	...	...	...
		Bhagalpur	...	...	...	...	...	...	...	...	...	...	...	...
	6	Cachar	...	...	...	...	...	...	...	...	...	...	...	...
	7	Thaton	...	...	...	...	...	...	...	...	...	...	...	...
		Pegu	...	...	...	...	...	...	...	...	...	...	...	...
		Toungoo Cantonment	...	...	...	...	...	...	...	...	...	...	...	...
	8	Meerut	...	...	...	...	...	...	...	...	...	...	...	...
		Bareilly	...	...	...	...	...	...	...	...	...	...	...	...
		Sitapur	...	...	...	...	...	...	...	...	...	...	...	...
		Bahraich	...	...	...	...	...	...	...	...	...	...	...	...
	9	Sambalpur	...	...	...	...	...	...	...	...	...	...	...	...
		Bilaspur	...	...	...	...	...	...	...	...	...	...	...	...
		Raipur	...	...	...	...	...	...	...	...	...	...	...	...
		Chanda	...	...	...	...	...	...	...	...	...	...	...	...
		Chhindwara	...	...	...	...	...	...	...	...	...	...	...	...
	Det.	Palamau	...	...	...	...	...	...	...	...	...	...	...	...
	Det.	Singhbhum	...	...	...	...	...	...	...	...	...	...	...	...
	N.-W. P. Land Records Survey.	Meerut	...	...	...	...	...	...	...	...	...	...	...	...
		Jhansi	...	...	...	...	...	...	...	...	...	...	...	...
		Bahraich	...	...	...	...	...	...	...	...	...	...	...	...
		Sitapur	...	...	...	...	...	...	...	...	...	...	...	...
		Shahjahanpur	...	...	...	...	...	...	...	...	...	...	...	...
		Kheri	...	...	...	...	...	...	...	...	...	...	...	...
		Bijnor	...	...	...	...	...	...	...	...	...	...	...	...
		Totals	...	...	...	...	...	...	...	...	...	...	...	...

Field Parties during the year 1895-96.

	TRAVERSING.				DETAIL SURVEY.					RECORD-WRITING.			REMARKS.
	Area in square miles.	Stations at which theodolite was set up.	Angular error per station in seconds.	Linear error per *mille*.	Area in square miles.	Plane-table fixings per square mile.	Linear miles of test lines.	Villages.	Average size of fields in acres.	Area in square miles.	Villages.	Fields.	
...	12·5	6,000	7	0·6	6·87(*a*)	...	104	...	...	...	...	...	(*a*) 2·64 square miles surveyed on 105·6-inch scale and 3·68 on 52·8-inch scale; remainder river area. (*b*) Revision of a previous survey. (*c*) Includes 4 square miles of village boundary survey. (*d*) Includes 7 square miles of revision survey. (*e*) Village boundary survey. (*f*) Survey of new cultivation only in 45 villages. (*g*) Records written by Settlement Officer.
...	...	...	...	...	1	...	6	...	...	...	...	...	
...	...	...	...	...	0·02	...	...	...	...	0·02	1	2,248	
...	...	...	...	...	0·17	...	...	...	...	0·17	1	...	
5	...	...	...	...	0·19	...	...	...	...	0·19	2	2,248	
...	...	...	...	...	32 (*b*)	...	...	35	0·47	62	58	84,709	
...	...	...	...	...	5 (*c*)	...	...	7	...	...	...	...	
...	...	...	...	...	37	...	...	42	...	62	58	84,709	
...	...	...	...	...	7 (*b*)	...	...	3	0·35	7	3	12,522	
10	1,501	26,093	1·9	0·7	...	...	...	...	...	...	...	...	
...	946	15,244	2·0	0·7	...	...	...	...	...	...	...	...	
...	246	5,123	5·0	0·5	193	...	...	188	1·71	...	...	...	
...	455	16,113	8·0	0·6	452	...	...	449	2·15	...	...	...	
...	152	11,496	3·0	0·5	142	...	...	330	0·46	...	...	...	
15	200	10,449	2·0	0·4	32	...	...	83	1·70	...	...	...	
...	955	14,568	7·0	0·6	1,187	...	...	1,068	2·62	...	...	...	
...	52	558	0·2	0·9	645	...	2,343	1,204	0·33	669	1,234	1,305,777	
...	386	5,872	2·0	0·2	1,185	...	5,140	1,047	1·30	1,185	1,047	602,166	
...	20	310	...	...	459(*d*)	...	1,635	442	0·51	459	442	583,142	
20	1,179	21,870	2·0	0·2	16	...	71	14	0·68	16	14	15,298	
...	23	512	...	...	29	...	353	27	1·00	32	29	24,261	
...	1	24	...	...	...	...	...	...	...	...	...	...	
...	58	1,842	...	...	54	...	322	66	0·50	47	60	60,420	
...	42 (*e*)	141	...	...	...	...	...	...	...	...	...	...	
25	164	7,484	6·0	1·5	349	...	1,243	359	1·44	...	...	...	
...	...	...	...	...	105	...	372	70	0·40	...	...	...	
...	714	13,693	8·0	0·8	491	...	2,397	182	0·56	...	...	...	
...	1	115	6·0	0·7	1	...	5	1	0·86	...	...	...	
...	492	6,833	2·0	0·4	...	...	...	...	...	...	...	...	
30	841	14,238	3·0	0·2	...	...	...	...	...	...	...	...	
...	216	3,784	9·0	0·4	...	...	...	...	...	...	...	...	
...	1,394	11,934	8·0	0·1	...	...	...	...	...	...	...	...	
...	395	7,773	3·4	0·3	...	...	...	...	...	...	...	...	
...	1,110	11,519	2·8	0·4	...	...	...	...	...	...	...	...	
35	923	10,283	2·6	0·6	...	...	...	...	...	...	...	...	
...	507	2,235	2·9	0·9	...	...	...	...	...	...	...	...	
...	394	6,363	5·4	0·3	...	...	...	...	...	...	...	...	
...	141 (*e*)	4,325	0·3	0·7	1	...	...	(*f*)	...	1	(*f*)	330	
...	229	8,319	1·0	0·2	...	...	...	...	...	...	...	...	
40	...	...	...	...	770	...	...	562	...	1,566	1,108	1,403,660	
...	...	...	...	...	660	...	...	298	...	1,498	595	530,980	
...	...	...	...	...	402	...	...	347	...	973	1,008	1,202,074	
...	...	...	...	...	134	...	...	98	...	134	98	95,554	
...	...	...	...	...	704	...	...	906	...	704	906	584,576	
45	...	...	...	...	430	...	...	469	...	430	467	294,292	
...	...	...	...	...	169	...	...	95	...	(*g*)	...	...	
...	13,737	239,113	...	...	8,610	...	13,881	8,305	...	7,714	7,008	6,702,530	

Summary of the outturn of work of the

Scale of Survey.	Number of Party.	Locale of field operations.		Triangulation. Instrument used. Diameter in inches.	Triangulation. Area in square miles.	Triangulation. Square miles to each point trigonometrically fixed.	Triangulation. Square miles to each height.	Secondary. Stations fixed.	Secondary. Triangular error in seconds.	Secondary. Error per mile in feet	Tertiary. Intersected points.	Tertiary. Error per mile in feet.	Spirit-levelling operations. Miles levelled over.	Spirit-levelling operations. Permanent bench-mark stones embedded.	Spirit-levelling operations. Trigonometrical stations connected with.
Inches to a mile. 8	3	Katha	...	...	...	...	...	...	...	...	...	...	...	...	...
	10	Hubli town	...	8	18	2·2	...	8	6	4·9	15	3·1	...	...	...
	17	Bombay (Forests)	...	7	225	3·7	3·7	54	10	0·2	206	0·2	...	...	...
		Totals	...	...	243	...	...	62	...	...	221	...	...	...	...
4	14	Central Provinces (Forests).	5	5 & 6	1,165	9·8	9·8	65	15	0·3	227	0·4	...	...	...
	17	Bombay (Forests)	...	7	280	7·1	7·1	36	12	0·3	159	0·2	...	...	...
	18	Himalayas	...	7 & 8	1166	0·4	0·5	50	22	0·2	216	...	...	...	...
	19	Madras (Forests)	...	5, 6 & 7	1,815	2·2	2·2	165	22	0·4	487	0·6	...	...	...
	20	Burma (Forests)	...	6	638	...	...	8	17	0·1	...	...	...	...	...
	Forest Branch.	Central Provinces (Forests).	10	7	804	...	...	37	...	...	80	...	...	...	...
	Forest Branch.	North-Western Provinces and Oudh (Forests).	...	7	392	3·8	3·7	11	4	0·3	91	0·4	...	...	...
	Forest Branch.	Punjab (Forests)	...	7 & 8	1,165	2·3	2·4	43	7	0·3	463	0·5	...	...	...
	Forest Branch.	Upper Burma (Forests)	...	...	...	...	...	...	...	...	...	...	...	...	...
	Forest Branch.	Lower Burma (Forests)	...	7 & 8	560	8·7	10·6	5	12	0·4	29	1·0	...	...	...
		Totals	15	...	6,935	...	...	420	...	...	1,752	...	...	...	...
2	7	Thaton	...	...	...	...	...	...	...	...	...	...	...	...	...
	10	South Maratha Country	...	...	...	...	...	...	...	...	...	...	...	...	...
	12	Sind	...	7	685	9	12	50	17	0·3	24	4·9	...	...	...
	15	Baluchistan	..	...	...	...	...	...	...	...	...	...	...	...	..
	18	Himalayas	20	...	...	...	...	...	...	...	...	...	...	...	...
	20	Burma (Forests)	...	...	...	...	...	...	...	...	...	...	...	...	...
		Totals	...	...	685	...	...	50	...	...	24	...	...	...	...
1	7	Thaton	...	...	...	...	...	...	...	...	...	...	...	...	...
	11	Upper Burma	...	6 & 8	1,830	4·1	5	71	15	0·3	372	0·6	...	...	...
	12	Sind	25	...	...	...	...	...	...	...	...	...	...	...	...
	15	Baluchistan	...	8	2,000	5·3	5·3	32	7	0·1	334	0·2	...	...	...
	18	Himalayas	...	...	...	...	...	...	...	...	...	...	...	...	...
	21	Upper Burma	...	6 & 8	4,544	8·6	1·9	69	13	0·7	408	1·2	...	...	...
	Forest Branch.	Punjab	...	...	...	...	...	...	...	...	...	...	...	...	...
		Totals	30	...	8,374	...	...	172	...	...	1,114	...	...	...	...
½	15	Baluchistan	...	6	5,200	...	...	19	...	...	24	...	...	...	...
¼	15	Baluchistan	...	6 & 8	12,000	...	...	...	...	...	...	...	...	...	...
	21	Upper Burma	...	...	...	...	...	...	...	...	...	...	...	...	...
		Totals	...	...	12,000	...	...	...	...	...	...	...	...	...	...
⅛	15	Persia	35	...	...	...	...	...	...	...	...	...	...	...	...
	24	Baluchistan and Upper Burma.	...	12 micro.	1,506	...	...	...	...	...	...	...	...	...	...
	25	India	...	...	...	...	...	...	...	...	...	...	278·5	24	4
		GRAND TOTALS	...	...	34,943	...	...	742	...	...	3,158	...	278·5	180	4

Field Parties during the year 1895-96—contd.

	TRAVERSING.				DETAIL SURVEY.					RECORD-WRITING.			REMARKS.
	Area in square miles.	Stations at which theodolite was set up.	Angular error per station in seconds.	Linear error per *mille*.	Area in square miles.	Plane-table fixings per square mile.	Linear miles of test lines.	Villages.	Average size of fields in acres.	Area in square miles.	Villages.	Fields.	
...	...	...	...	...	2	...	...	...	...	...	...	...	(a) Tested *in situ*. (b) Excludes an area of 394 square miles triangulated but not yet computed.
...	18	172	0·1	0·2	18	...	...	...	...	...	...	...	
...	...	...	...	...	108	162	85	...	...	...	...	...	
...	18	172	...	...	128	...	85	...	...	...	...	...	
	...	10,691	6·0	1·0	651	...	384	...	...	...	...	...	
...	...	1,926	0·3	0·9	829	88	121	...	...	...	...	...	
...	...	...	...	...	413	...	(a)	...	...	...	...	...	
...	...	7,018	19	2·3	964	52	(a)	...	...	...	...	...	
...	...	14,705	3·4	2·8	339	212	136	...	...	...	...	...	
	...	715	6·1	6·9	1,025	214	534	...	...	...	...	...	
...	...	733	8·6	3·2	421	130	144	...	...	...	...	...	
...	...	...	...	...	92	...	(a)	...	...	...	...	...	
...	...	1,521	6·0	4·5	174	215	60	...	...	...	...	...	
...	...	5,602	0·8	5·4	...	...	...	...	...	...	...	...	
	...	42,911	...	...	4,908	...	1,379	...	...	...	...	...	
...	...	...	...	...	228	9	...	...	...	...	...	...	
...	...	...	...	...	1,757	22	309	...	...	...	...	...	
...	2,865	7,454	3·4	1·5	1,241	21	44	...	...	...	...	...	
...	...	...	...	...	702	...	78	...	...	...	...	...	
	...	...	...	...	316	...	(a)	...	...	...	...	...	
...	...	...	...	...	111	71	20	...	...	...	...	...	
...	2,865	7,454	...	...	4,355	...	451	...	...	...	...	...	
...	...	...	...	...	336	5	...	...	...	...	...	...	
...	...	...	...	...	1,355	6	64	...	...	...	...	...	
	...	...	...	...	677	16	(a)	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	88	1·5	...	...	...	...	...	...	
...	...	...	...	...	937	6	(a)	...	...	...	...	...	
...	...	...	...	...	621	28	(a)	...	...	...	...	...	
	...	...	...	...	4,014	...	64	...	...	...	...	...	
...	...	...	...	...	11,307	0·81	(a)	...	...	...	...	...	
...	...	...	...	...	11,200	...	...	...	...	...	...	...	
...	...	...	...	...	5,079	...	...	...	...	...	...	...	
...	...	...	...	...	16,279	...	...	...	...	...	...	...	
	...	...	...	...	14,000	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	...	...	...	Trigonometrical operations only.
...	...	...	...	...	...	...	...	...	...	...	...	...	
...	16,632	295,650	...	...	63,653	...	15,970	8,350	...	7,783	7,071	6,802,009	

Statement showing the cost-rates of work executed by the

Number of party.	Nature and *locale* of field operations.	Cost-rate per square mile in rupees.							
		Triangulation.	Traversing.	Detail survey and preparation of maps on scales of					
				½"	1"	2"	4"	8"	16"
	Topographical Surveys.	R	R	R	R	R	R	R	R
10	South Maratha Country	...	6·2	...	...	20·5	...	129·2	...
11	Upper Burma	16·5	...	...	40·7	...	...	...	...
12	Karachi	19·7	9·4	...	10·4	24·9	...	...	...
	Hyderabad		16·9(*c*)	...	...	...	...	...	...
15	Sind	3·3	...	...	...	...	...	...	...
	Zhob	2·0	...	4·0	...	...	...	...	...
	Multan	...	5·4	...	...	16·3	...	...	...
	Pishin	...	15·0	...	...	...	..	...	...
18	Himalayas	19·8	...	...	12·8	49·1	85·5	...	...
21	Upper Burma	10·0	...	...	31·9	...	...	...	...
	Forest Surveys.								
14	Central Provinces	6·5	13·6	...	...	...	81·2	...	...
17	Bombay	5·4	12·2	...	...	...	66·7	122·4	130·0
19	Madras	11·5		...	...	...	54·3	...	...
20	Lower Burma	21·2	58·5	...	...	85·3	158·1	...	...
(Forest Survey Branch.)	Chamba	3·0	...	...	11·5	...	36·9	...	...
	Raipur	...	7·3	...	...	...	43·2	...	...
	Balaghat	...	8·9(*i*)	...	...	...	25·9	...	...
	Nagpur, Seoni and Chhindwara	14·5	...	...	...	...	67·9	...	...
	Jubbulpur and Mandla	...	...	...	...	...	42·8	...	...
	Saugor	8·0	...	...	...	..	42·4	...	...
	Lalitpur	12·7	...	...	...	...	45·3	...	...
	Oudh	...	9·0	...	...	...	18·4	...	...
	Tenasserim	7·4	19·0	...	...	...	...	...	...
	Pyinmana	...	31·3(*i*)	...	...	...	91·9	...	...
	Cadastral Surveys.								
3	Shwebo	...	70·4	...	...	...	...	...	92·3
	Yamethin	...	73·9	...	...	...	...	...	62·5
	Katha	...	89·4	...	...	...	...	73·0	72·0
	Upper Chindwin	...	69·1	...	...	...	...	...	134·1
	Myingyan	...	52·1	...	...	...	...	...	82·9
4 & 5	Saran	...	56·0	...	...	...	...	...	71·0
	Champaran	...	24·0	...	...	...	...	...	56·5
	Muzaffarpur	...	...	...	...	...	...	...	85·2
	Gaya	...	56·1	...	...	...	...	...	39·7
	Darbhanga	...	19·5	...	...	...	...	...	51·1
	Monghyr	...	38·1	...	...	...	...	...	156·4
6	Cachar	...	71·2	...	...	...	...	..	100·1
7	Pegu	...	41·1	...			...	...	116·1
	Thaton	...	...	...	28·0		...	...	159·7
Det.	Palamau	...	54·0	...	...	...	...	...	...
Det.	Singhbhum	...	43·8	...	...	...	...	...	...
	Traverse Surveys.								
2	Shahjahanpur	...	25·3	...	...	...	...	...	...
	Kheri	...	28·2	...	...	...	...	...	...
8	Meerut and Bareilly	...	24·7	...	...	...	...	...	...
	Bahraich and Sitapur	...	19·	...	...	...	...	...	...
9	Central Provinces	...	22·5	...	...	...	...	...	...

several Field Parties during the year 1895-96.

	Cost-rate per acre in annas.	COST-RATE PER SQUARE MILE IN RUPEES.				
	Cadastral survey, including traversing, detail survey and mapping.	Stone embedding.	Records (*Khanapuri*).	Completion of vernacular records, assessment statistics, etc.	Total cost, inclusive of charges for instruments to Provincial Governments.	REMARKS.
	Annas.	R	R	R	R	
...	...	...	...	...	47,157(*a*)	
...	...	...	...	...	94,175(*b*)	
...	...	...	...	...	} 93,471(*d*)	
...	...	...	...	...		
5	...	...	...	...		
...	...	...	...	...	} 110,490(*e*)	
...	...	...	...	...		
...	...	...	...	...		
...	...	...	...	...	68,751(*f*)	
10	...	...	...	...	90,015(*g*)	
...	...	...	...	...	96,827(*h*)	
...	...	...	...	...	77,368	
...	...	...	...	...	75,900	
...	...	...	...	...	116,297	
15	...	...	...	...	44,020	
...	...	...	...	...		
...	...	...	...	...		
...	...	...	...	...	} 59,626(*j*)	
...	...	...	...	...		
20	...	...	...	...		
...	...	...	...	...	6,041	
...	...	...	...	...	7,798	
...	...	...	...	...	14,766	
...	...	...	...	...	18,026	
25	4·07	4·7	...		37,191	
...	3·41	4·9	...		69,284(*k*)	
...	4·04	6·1	...	} 4·7 {	25,562	
...	5·08	4·5	...		33,201(*l*)	
...	3·38	3·3	...		157,393(*m*)	
30	3·17	...	41·4	34·8	100,434(*n*)	
...	2·01	...	27·4	20·0	132,541(*o*)	
...	2·13	...	37·6	49·4	102,317(*p*)	
...	2·39	...	18·3	18·0	16,506(*q*)	
...	1·77	3·7	34·8	17·5	29,022	
35	4·86	1·9	62·6	52·3	19,974(*r*)	
...	4·28	...	...	46·1	84,391(*s*)	
...	3·92	...	...	...	157,792(*t*)	
...	3·99	...	...	...	38,214(*u*)	
...	...	7·2	...	...	17,044(*v*)	
40	...	...	...	...	11,253(*w*)	
...	...	4·1	...	...	45,164	
...	...	6·9	...	...	33,184	
...	...	3·6	...	...	37,821	
...	...	1·0	...	...	33,316	
45	...	1·6	...	...	80,055	

REMARKS.

(*a*) Includes R6,926 expended on Gujarat General Report.
(*b*) Includes R6,862 expended on survey of the Karenni boundary and R5,475 on secondary triangulation.
(*c*) In Hyderabad the village boundaries were surveyed.
(*d*) Includes R1,596 expended on special survey for Irrigation Department; R5,750 on 4-inch and 2-inch mapping, and R1,025 on the survey of Karachi city.
(*e*) Includes R27,754 expended on ¼-inch and ½-inch geographical surveys.
(*f*) Includes R670 expended on revision of 24-inch map of Simla and demarcating Simla boundaries; R4,342 on instruction of soldier-surveyors and pupils; and R12,410 on arrears of mapping.
(*g*) Includes R9,197 expended on Anglo-Siamese boundary commission, and R19,149 on ¼-inch geographical surveys.
(*h*) Includes R6,506 expended on the classification of forest soils; R152 on revisionary survey of Mussoorie; R750 on instruction of soldier-surveyors; and R4,127 on arrears of mapping and computation.
(*i*) Rate calculated per linear mile.
(*j*) Includes R1,907 expended on levelling in Raipur and Saugor.
(*k*) Includes R3,639 expended on 2-inch and 16-inch contouring of 174 and 48 square miles.
(*l*) Includes R14,024 expended on revision survey.
(*m*) Includes R414 expended on Manipur boundary survey.
(*n*) Includes R3,582 expended on Majhaulia Ward's Estate survey.
(*o*) Includes R160 expended on Bettiah town survey.
(*p*) Includes R15,906 expended on revision of Col. Barron's survey; R1,074 on revision of Darbhanga Raj villages; R503 on revision of survey of 1892-93; R614 on Hajipur *diara* survey; R2,803 on Sabalpur estate survey; R1,102 on Muzaffarpur town survey; R51 on Hajipur Municipality survey; R108 on Lalganj Municipality survey; R309 on Sitamarhi Municipality survey, and R157 on Sadipur-Manikpur boundary survey.
(*q*) Includes R5,338 expended on new survey of Belkhara *mahal*; R8,650 on revision survey of Belkhara *mahal*; R335 on Tikari Estate survey, and R201 on Tikari Municipality survey.
(*r*) Includes R1,705 expended on Chaurasi estate survey; R1,070 on Tantibunia estate survey; R715 on Tintanga boundary survey; R462 on Backerganj *diara* dispute, and R107 on Mussoorie Municipality survey.
(*s*) Includes R3,280 expended on demarcation; R4,056 on survey class; R3,016 on 2-inch mapping of district Jaintiah; R9,121 on revision survey, and R546 on miscellaneous work for the Director of Land Records.
(*t*) Includes R68,708 expended on Rangoon city survey; and R2,769 on demarcation.
(*u*) Includes R5,051 expended on Amherst and Thaton 1-inch and 2-inch mapping, and R609 on Toungoo cantonment survey.
(*v*) Includes R5,357 expended on demarcation; and R196 on Daltonganj Municipality survey.
(*w*) Includes R1,214 expended on arrears of traversing.

Particulars of Cadastral Surveys completed since 1894-95.

District.	Scale of survey.	Number of villages.	Number of fields.	Area surveyed.	Average size of fields.	Cost, exclusive of demarcation and charge for instruments.	Rate per square mile. Traverse survey.	Rate per square mile. Cadastral survey.	Rate per square mile. Cadastral survey with Record of Rights.	By whom and when surveyed.
				Sq. miles.	Acre.	R	R a. p.	R a. p.	R a. p.	
Muzaffarpur	16" = 1 mile	3,844	3,612,222	2,618	0·46	4,32,869	37 13 9	65 5 10	149 2 3	Mr J S. Pemberton and Captains G. B. Hodgson and R. T. Crichton during 1891—96.
Champaran	16" = 1 mile	2 654	2,777,519	3,280	0·76	4,49,293	31 5 7	60 5 8	109 4 10	Captains G. B. Hodgson and R. T. Crichton during 1892—96.
Sylhet (part of)	16" = 1 mile	627	272,481	556	1·31	96,011	30 8 11	93 12 5	134 1 11	Mr. E. C. Barrett during 1891—93.
Thaton	16" = 1 mile	1,386	1,278,166	2,338	0·43	3,39,645	42 8 0	102 12 0	...	Messrs. C. Wood and B. G. Gilbert-Cooper during 1890—96.

PART III.

THE OPERATIONS AT THE HEAD-QUARTERS OFFICES.

478. These offices comprise—

(1) The Head Quarters Offices at Calcutta.
(2) The Trigonometrical Branch Office at Dehra Dun.
(3) The Drawing Office at Simla.
(4) The Forest Survey Branch Office at Dehra Dun

A detailed description of the work carried on in each office is given below :—

I.—HEAD-QUARTERS OFFICES, CALCUTTA.

SUPERINTENDENCE, CORRESPONDENCE AND ACCOUNTS.

Superintendence.

Colonel C. Strahan, R.E., Surveyor-General of India.
Colonel J. E. Sandeman, S.C., Deputy Surveyor-General, in charge Revenue Branch, from 28th October, 1895.
Colonel W. H. Wilkins, S.C., Officiating Deputy Surveyor-General, in charge Revenue Branch up to 27th October, 1895.
Colonel M. W. Rogers, R.E., Assistant Surveyor-General, from 15th November, 1895.
Mr. T. A. Pope, Officiating Assistant Surveyor-General up to 14th November, 1895 and Personal Assistant to the Surveyor-General up to the 5th April, 1896.
Mr. T. W. Babonau, Registrar.

Correspondence.		*Accounts.*	
Mr. T. A. Milne, Head Assistant.		Mr. C. O. Gray,	Head Clerk.
„ G. C. Walker, Head Clerk.		„ J. A. Vallis,	Clerk.
Babu Kalipodo Banerji,	Clerk.	Babu Rajkrishna Mukerji,	„
„ Banimadhub Banerji,	„	Mr. E. A. Bonnaud,	„
„ Chuni Lal Dey,	„	Babu Hem Nath Dutt,	„
„ Durga Narayan Ghose,	„	and seven others.	
„ Ramkristo Chunder,	„		
Mr. H. E. D'Cruz.	„		
Babu Gopal Chander Dass,	„		
„ Kali Kristo Chander	„		
and eleven others.			

479. The general direction of these offices remained in the hands of Colonel C. Strahan, R.E., throughout the year. The Revenue Branch Section was under Colonel W. H. Wilkins, S.C., up to the 27th October, 1895, and thereafter under Colonel J. E. Sandeman, S.C. The General and Topographical Branch Sections were under Mr. T. A. Pope up to the 14th November, 1895, and thereafter under Colonel M. W. Rogers, R.E. Mr. T. A. Pope held the office of Personal Assistant to the Surveyor-General from the 15th November, 1895.*

* The Assistant Surveyor-General reports as follows :—

Mr. T. W. Babonau, Registrar, has continued in the general superintendence of the office, which he has carried on to my entire satisfaction.

Messrs. Milne and Gray have superintended their respective sections very satisfactorily, and Mr. J. A. Vallis has carried out the arrangements for the despatch of survey *khalasis* to Burma in a very satisfactory manner.

All the clerks have worked well, especially Babus Banimadhub Banerji, Chuni Lal Dey, Rajkrishna Mukerji, Mr. E. A. Bonnaud, and Babus Gopal Chander Dass, Kanti Chunder Sen and Mohendro Chander Aich.

The Deputy Surveyor-General reports that in the Revenue Branch Office, Babus Kalipodo Banerji and Ramkristo Chunder, Mr. H. E. D'Cruz, Mr. N. N. Laha and Babu Norendro Nath have all worked well.

DRAWING OFFICE.

Personnel.

Mr. C. F. Erskine, Deputy Superintendent, 2nd grade, in charge up to 8th May 1896.
Mr. A. E. Spring, Deputy Superintendent, 2nd grade, in charge from 9th May 1896.
Mr. L. J. Pocock, Chief Draftsman.
" G. D. Cusson, Officiating Head Draftsman.
" W. Green, Draftsman.
" A. J. Musgrove, "
" J. R. Adels, "
" R. C. Sinclair. "
" A. S. Bateman, "
" A. J. Rodrigues, "
" A. J Wilson, Jr. "
" W. Hecquet, " up to 9th September 1896.
" E. A. Knight " from 10th September 1896.

Native Draftsmen.

Babu Purna Chandra Sen.
Munshi Muttvullah.
Babu Gopal Chandra Roy, up to 2nd February 1896.
Munshi Abdul Aziz.
" Rahim Bakhsh.
" Abdur Razak.
Babu Tincowry Sen.
" Sarat Chandra Chatterjee.
" Bacharam Banerjee.
" Ram Chandra Sen.
" Narendra Nath Mookerjee.
" Subodh Chandra Sarkar.
And 64 others.

Additional Establishment.

Mr. J. A. Higgs, Draftsman, and 7 Native Draftsmen.

Extra Assistant Superintendents and Sub-Assistant Superintendents on duty.

Mr. J. A. Barker. Extra Assistant Superintendent, 4th grade.
Mr. T. Shaw, Extra Assistant Superintendent, 6th grade.
Mr. W. C. G. Barckley, Extra Assistant Superintendent, 6th grade, up to 8th September 1896.
Mr. G. Campbell, Extra Assistant Superintendent, 6th grade.
Mr. S. O. Madras, Sub-Assistant Superintendent, 1st grade.
Mr. W. H. D. Ewing, Sub-Assistant Superintendent, 1st grade.
Mr. O. D. Smart, Sub-Assistant Superintendent, 1st grade, up to 11th November 1895.
Mr. A. B. Smart, Sub-Assistant Superintendent, 1st grade, from 4th February 1896.
Mr. M. F. Berkeley, Sub-Assistant Superintendent, 3rd grade, up to 30th November 1895.
Babu Sarat Chandra Sen, Sub-Assistant Superintendent, 2nd grade, from 28th January 1896.

480. The superintendence of the Drawing Office during the year under report was held by Mr. C. F. Erskine up to 8th May 1896, and thereafter by Mr. A. E. Spring.

Mr. L. J. Pocock held the post of Chief Draftsman throughout the year.

There has been a slight change in the organisation of this office, owing to the superintendence of the Bengal Provincial Drawing Office being transferred to the officer in charge of the Head-Quarters Drawing Office from the 1st January 1896.

SECTION I.—GEOGRAPHICAL, DRAWING, AND COMPILATION.

481. The more important part of the work performed by this section during the year under report has been the progress and completion—as far as material was available—of the maps of Burma referred to as being in progress in paragraphs 609 and 610 of last year's Annual Report. Of the four sheets mentioned in the former paragraph, two sheets, Nos. 15 N. W. of the N. E. F. series and 2 N. W. of the S. E. F. series, have been published; and two sheets, Nos. 3 S. E. and 3 A. N. E. of the S. E. F. series, are still incomplete, owing to work of greater importance requiring attention.

With regard to the eight maps on the 8-mile scale mentioned in paragraph 610 of last Annual Report, three sheets, Nos. 1, 5, and 6, are in an advanced stage of progress; two sheets, Nos. 23 of the N. E. F. series and 4 of the S. E. F. series, have been held in abeyance for the incorporation of fresh geographical detail forthcoming from the field parties; whilst, of the remaining three sheets of the same series, two sheets, Nos. 9 and 10, are in course of publication, and one, sheet No. 13, has been published.

482. In connexion with the maps of these series, advantage has been taken of an opportunity offered by the Financial Commissioner of Burma to have all the boundaries corrected on the office copies.

483. Two new sheets, Nos. 314 and 358, of the topographical survey of Upper Burma, on the 1-inch scale, have also been in progress; and will, in all probability, be published by the beginning of next year, as the fair drawing of both these sheets has been completed.

484. Of the general maps the following are the more important ones calling for any separate remark :—(i) The map of Afghanistan on the 24-mile scale, (ii) the canal map of India on the 32-mile scale, and (iii) the new engraved map of India on the 128-mile scale. To the first there is being added fresh geographical information obtained by the operations of this Department since the last publication; the second has gone through a course of revision which almost constitutes it a re-compilation, as the symbols showing the canal system had to be entirely changed in accordance with instructions received from the Public Works Department; the third is a map of India recently engraved in outline only, and to enable the etching of hills on the copper plate to be commenceed, the hill shading of this map was taken in hand and completed in brush-work during the year.

485. The 32-mile map of India, third edition, still awaits the orders of the Government of India regarding the insertion of the frontier boundaries.

486. The provincial maps on the 16-mile scale have all been through various stages of revision with reference to the railway lines, the boundaries, and the principal roads; whilst the hill shading of the map of Bengal, Behar, and Orissa, and the outlining of additional matter falling into the blank portions of the maps of Bombay and Central India Agency, have been taken in hand and completed. The map of Madras belonging to this series has also had the compilation of the Island of Ceylon completed from data supplied by the survey authorities of that Colony.

487. One hundred and forty-six sheets of the Atlas of India have been in hand during the year. Additions to railways, roads, canals, and changes to boundaries were carried out on sixty-six sheets; additions to names and detail for eangraving on seventy-five sheets; and on the remaining five sheets the hill shading was done in brush for engraving.

488. Of the 1-inch standard maps of the Central India Agency, of the Central Provinces and of the Rajputana Agency, which are being completed to margin, fifty-six sheets are in different stages of progress, and six sheets have been completed and published; of the latter, two sheets are in the Central Provinces and four in Central India and Rajputana.

489. The current work of this section includes the corrections and additions to thirty-three administration report maps on different scales; the preparation of indexes intended for incorporation in this report, as well as a few others for special purposes; the keeping up to date of the colouring of all the office copies and the daily discharge of a large amount of correspondence, departmental, extra-departmental, and from private individuals, amounting in the aggregate to nearly fourteen hundred letters.

SECTION II.—REVENUE.

490. The work of this section has been, as in former years, the examining and preparing for photo-zincography of the fair maps received from the field parties of the Revenue Branch; in bringing up to date and republishing the old maps; in the preparation of the index maps for field parties and for the General Report; in colouring maps on all scales; in tracing maps and plans and supplying data to Government officials and others. The examination of the field traverse books, computation, etc., on which the several Revenue Surveys are based, is also done in this section.

491. A large number of sheets of Punjab, Bengal, and North-West and Central Provinces on the scale of 1 inch=1 mile were corrected and additions made thereto from material furnished by latest surveys and from data supplied by Settlement and other officers. The old 1 inch=1 mile maps of the Central Provinces were also revised by the boundaries and interior details being corrected from tracings of the 16 inch=1 mile scale maps received from the Settlement Officers. This was done with a view to preparing a revised second edition of the old Central Provinces maps which were published many years ago, and now require very heavy changes and additions to bring them up to date.

492. A large-scale plan of the Belgaum Cantonment was published on the scale of 8 inches=1 mile; and a plan of the hill station of Naini Tal was also published in 5 sheets on a scale of 20 inches=1 mile.

493. The map of Moulmein Town in 67 sheets on a scale of 1 inch=50 feet has also been dealt with in this office, and will shortly be ready for publication. It has been delayed owing to the original map having been drawn in faint pink lines; these have been strengthened and the general appearance of the map greatly improved.

494. As usual a large amount of work has been done for other Departments. A map of Lucknow on scale 3 inches=1 mile, showing the British position and the military operations in 1857-58 was completed for the Military Department; also a similar map of Cawnpore on the 2-inch scale, and of Bassiratganj and Bithur on the 4-inch scale, to illustrate the military operations in and around these localities during the suppression of the Mutiny in 1857-58.

495. A map of the Hooghly River in two sections, embracing a strip of country on both banks, was also completed and published on a scale of 2 inches=1 mile.

496. The map of Calcutta and Suburbs in four sections on scale 3 inches=1 mile was reprinted with additions and corrections to date.

497. The series of special district maps on the ½-inch scale prepared for the North-Western Provinces Government has been nearly completed by the publication of the Mirzapur and Naini Tal sheets; the map of Garhwal, the last of the series, is now passing through the press.

498. The traverse computations of the field parties working in districts Mandalay, Minbu, Mergui, Chittagong, Tipperah and Lakhimpur were examined. Traverse data, calculation of areas and such like information has, as usual, been prepared in this office and supplied to field parties and district officers. This work causes a very heavy strain on the office, as no less than 1,240 pages of traverse data have had to be copied and supplied; besides 60 pages of computations of direct distances between trijunction pillars calculated of traverses in district Ferozepur. Eighty-five village plots on the 16-inch scale were also supplied to the Settlement Officer, Raipur.

499. The areas of all the tea estates in district Darjeeling were calculated. The area and cost of all Cadastral, Topographical and Trigonometrical Surveys executed in Burma for the years 1877 to 1895 were prepared: and also areas of districts in Lower Burma surveyed by Revenue Survey parties: the areas by *parganas* of 8 standard sheets were calculated, as also 250 sheets on the 2-inch scale supplied by the Burma Provincial Survey. Thirty-six tracings of sheets and forty-one tracings of village plans were also made and supplied to district and other officers. Two hundred and four maps on various scales were coloured.

500. A large amount of correspondence has, as in former years, passed through this office, the number of letters dealt with being 1,454.

SECTION III.—CADASTRAL.

501. During the year under report this section consisted of one Sub-Assistant Superintendent, one writer, six permanent native draftsmen and six tracers or extra draftsmen, who were all employed in preparing cadastral maps for publication.

502. The procedure hitherto in vogue of strictly examining the serial numbering of fields and blocks in each sheet and noting that all holdings and divisions were correctly tabulated in the area statements which is the work of the field parties has been dropped, and now more attention is paid to the examination of the maps in order to ascertain whether the sheets are fit, in every way, for photographic reproduction.

503. In the North-West Provinces, the returns for the previous year showed no sheets remaining for publication. Subsequently, sanction was received from the Provincial Government to print the maps of Garhwal, and during the year 2,255 sheets of this district have been published out of a total of 9,100 sheets received, thus leaving a balance of 6,845 to be dealt with in the following seasons.

504. In Burma the publication of the maps of the following districts was proceeded with:—Amherst, the sheets of which have all been published, and Thaton in Lower Burma, and Mandalay, Meiktila, Minbu and Sagaing in Upper Burma. Of the Lower Burma sheets 1,018 have been published and of Upper Burma 1,568; in addition to these, 799 sheets of Upper Burma have been prepared for publication.

505. In Assam there have been no sheets published during the past twelve months and no maps were received from the party during the same period.

506. The total number of maps passed for publication during the year was 4,942, of which 4,927 were actually printed, 3,532 having been photo-zincographed and 1,395 zincographed, including 86 sheets of the Cuttack Municipality on the scale of 64 inches=1 mile, which were printed at the request of the Board of Revenue, Lower Provinces. At the close of the year there were remaining to be published 8,916 sheets against 2,004 in the last year; this increase is mainly due to the large number of maps that have been received of Garhwal district.

507. During the year, 100 portfolios have been prepared to receive the original maps for record in this office. In former years the sheets were bound together in volume form, but this method has now been altered, and in its stead the sheets are punched and eyelets affixed and are kept together by means of tape. One hundred sheets are put into each portfolio.

SECTION IV.—BENGAL PROVINCIAL.

508. The maps which have been dealt with during the year are those of Orissa and Bihar.

Orissa.

509. Nearly the whole of the work done during the year has been on the maps of Orissa. During the year 634 original cadastral maps were received from Orissa and the drawing of the reduced standard sheets from them was completed. As the revised cadastral maps of Killa Khurda will now be coming in, the standard mapping of the whole of Orissa will be completed early during the coming year.

510. Owing to some incorrect survey in *pargana* Sukinda, the field sheets were returned to Orissa for revision. These have now been received back adjusted and the drawing will be shortly completed.

511. Nineteen traces on the 2-inch scale of the country lying two miles on either side of the Bengal-Nagpur Railway from Cuttack to the north-western boundary of Orissa were sent to the Under-Secretary to the Government of India, Public Works Department (Construction), in order that the new line might be correctly marked on the maps about to be published. The tracings were sent on the 2nd of July 1896, and received back on the 26th of September 1896. As some doubt has arisen concerning the accuracy of the alignment shown on the map, one of the tracings has been returned to the Under-Secretary for investigation, and so the railway line has not yet been shown on the maps.

512. Up to the 30th September 1896 44 sections of standard sheets Nos. 138, 139, 167, 168, 169, 195, 196, 197, 222, 223 and 224 on the 2=inch scale were sent to the Photographic office for reduction to the 1-inch scale. Sheets Nos. 168, 195, 196, 197, 222, 223 and 224 have passed through the examining office. Unpublished proofs have been sent to the local authorities for scrutiny, and when these have been received back the publication of the maps will be proceeded with.

513. The Under-Secretary to the Government of Bengal in his No. 853I. dated 31st July 1893, asked that a special publication be made on the scale of 2 inches = 1 mile of 26 sections of the Orissa standard sheets. Of these 21 sections have been reproduced by photography and unpublished proofs forwarded to the Superintending Engineer through the Under-Secretary for examination, after which the maps will be printed for the use of the Government of Bengal. The cost of this special publication will be met by the Government of Bengal and will not be a charge against the budget of the Bengal Drawing office.

514. Besides the work of actual geographical mapping, traces were being continually prepared of undecided boundary disputes shown on the cadastral maps for despatch to the field party. The boundaries as decided by the Settlement Officer were afterwards transferred in red to the original field plans.

Bihar.

515. As stated in last year's Annual Report, paragraph 82, the supply of maps from the field parties had failed altogether and so the whole establishment was employed on Orissa mapping at the commencement of the year under report. Altogether 7,047 sheets of 5,123 villages were received in this office during the year under report, about half of them reaching Calcutta at the very end of the year.

516. Mapping of the Bihar sheets has now been resumed and will progress steadily. There is the drawback, however, of a great part of the traverse computations being still with the field parties; when these are received work should be in full swing.

517. The reductions to the 2-inch scale have been made of 4,133 sheets of Bihar. Of these, 3,199 have been examined against the original field plans prior to their being transferred to the fair maps. The values of co-ordinates of triple junctions to origin of survey have been calculated for 1,585 *mauzas*.

Chittagong.

518. As noted in paragraph 83 of last year's report sanction had been received for the preparation of new geographical maps of Chittagong.

519. With the exception of Thanah Ramu the whole of the maps are still with the Settlement Officer and the date of their receipt in this office is most uncertain.

520. There are 3,105 cadastral sheets of the Chittagong survey. Of these only 301 have been deposited in the Surveyor General's Office and pentagraphed to scale 2 inches = 1 mile.

521. The following statement shows the number of cadastral maps received

in the Bengal Drawing Office during the year, the number reduced by pentagraph to scale 2 inches=1 mile and the number remaining to be pentagraphed :—

LOCALITY.	Number of maps received during year ending 30th September 1896.	Number of maps reduced by pentagraph.	Remaining for reduction to 2-inch scale.
Bihar	7,047	4,133	2,914
Orissa	634	634	Nil.
Chittagong	301	301	Nil.
TOTALS	7,982	5,068	2,914*

ENGRAVING OFFICE.

522. Mr. C. F. Erskine held charge of this office up to the 8th May 1896, when he left the Head-quarters to assume charge of a field party and was relieved by Mr. A. E. Spring. Mr. W. Donaldson retired on the 8th November 1895.

Personnel.

Mr. C. F. Erskine, Deputy Superintendent, 2nd grade, in charge up to May 8th, 1896.
„ A. E. Spring, Deputy Superintendent, 2nd grade, in charge from May 9th, 1896.
„ J. Fulford, Head Engraver.
„ W. Donaldson, Engraver, up to November 8th, 1895.
„ S. M. Coard, Engraver.
„ T. B. Rodger, „
„ A. W. N. James, „
„ A. R. Coard, „
„ E. Earle, „
„ E. C. V. Ollenbach, „
„ L. H. Musgrove, „
„ F. R. C. Scallan, „
„ A. T. Vieux, „
„ A. E. Cann, „
30 Native Engravers.
2 Apprentices.

Copper-plate Printing Section.

Mr. W. T. Collins, Copper-plate Printer.
„ A. E. Pilley, Assistant Copper-plate Printer and Storekeeper.

523. The outturn of work has been satisfactory. The number of plates worked on during the year was 270. The amount of "Ornament" engraved is considerably less than last year, and of outline-engraving a little less, but there has been a large increase in the number of letters cut which more than makes up for this deficiency.

524. Six quarter sheets of the Atlas of India and 18 district maps for administration purposes have been published, and also the nine sheets of the 16-inch map of Calcutta, the 128-mile map of India, the 16-mile map of Gujarat, and the 80-mile railway map of India. A section plate and two scale plates have been engraved and three brass plates were completed, with inscription, for the standard bench-marks of Calcutta.

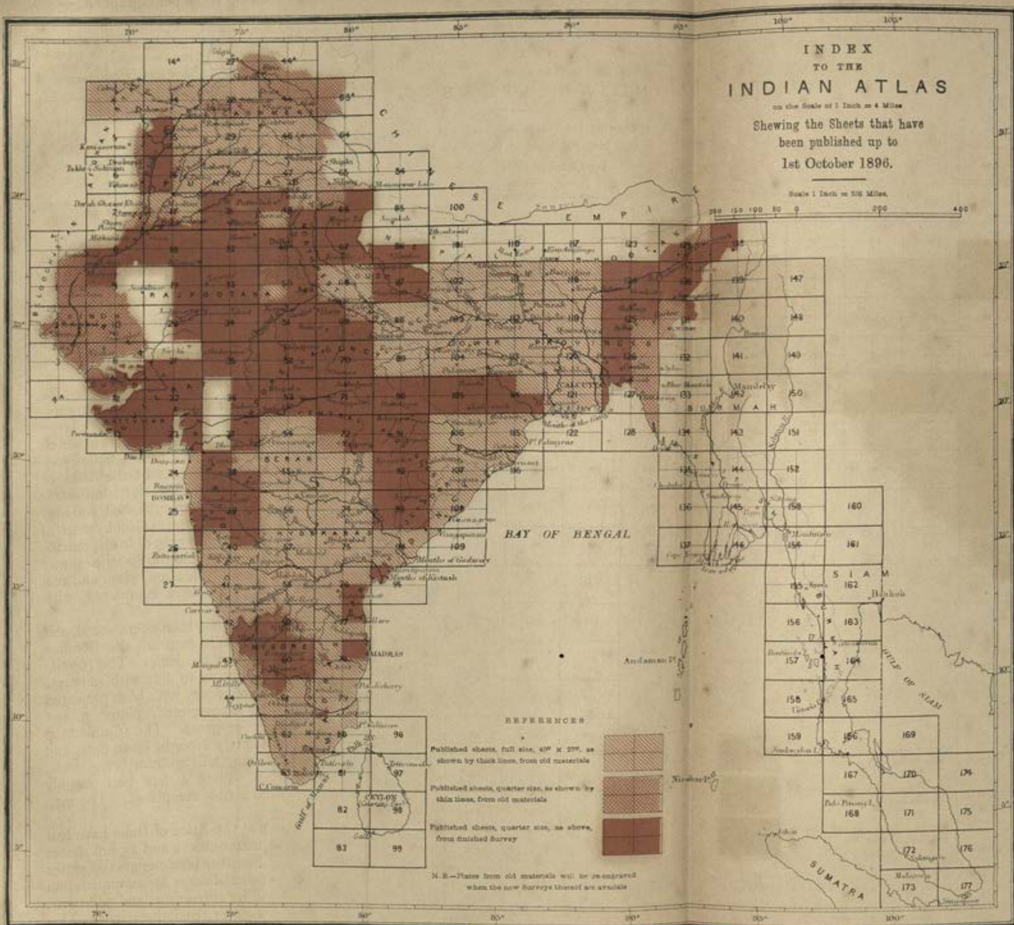
525. A new 16-mile map of Bengal, in two sheets, has been commenced, and the outline of both sheets is well advanced. The 16-mile map of the Bombay Presidency has been continued as new material became available. The 16-mile map of the Central India Agency is being brought up to date with railways. Plates 1, 4 and 6 of the 16-mile map of the Madras Presidency have been projected and the degree figures cut; the writing on plate 2 is completed, plates 3 and 5 are well advanced, and the outline of Ceylon is in progress. The 16-mile map of the Punjab, in four sheets, has been completely brought up to date, and matrices and duplicates of the three plates containing hills are now being made. The hills on plate 1 have just been commenced. Plate 4 has been largely corrected, as new material has been supplied, and is now completed. The map will shortly be published in outline and writing.

526. Forty-seven unpublished quarter sheets of the Atlas of India have had new work engraved upon them, and 61 published quarter sheets and 25 full sheets have been in hand for corrections and additions. Fourteen photo-engraved plates were lettered for the Photo-litho Office. Five provincial maps for administration reports and four index maps have also been in hand for corrections and additions.

527. The Copper-plate Printing Section has taken 21,181 impressions. This is a smaller number than last year, partly on account of a smaller demand for engraved maps. The number of transfers taken was 155 in excess of last year, and as these take much longer to print than ordinary impressions the presses have been kept in full work. The number of plates steel-faced during the year was 204.†

* Mr. Spring reports that Mr. Pocock and Mr. Cusson in their posts as Chief and Officiating Head Draftsmen, respectively, supervised their establishments most efficiently, Messrs. Barker, Shaw and Higgs have also done very well as heads of the Examining, Bengal Drawing and Cadastral Sections. Mr. Madras has also done good work. The European draftsmen have been well reported on, especially Messrs. Musgrove and Sinclair, and of the native establishment Babu Sarat Chunder Chatterjee, Narandra Nath Mookerji, Subodh Chandra Sircar, Purna Chandra Sen, amongst others, have rendered good service.

† The Head Engraver, Mr. Fulford, has given great satisfaction in the discharge of his duties, and he reports well of all his assistants.



Reg. No. 238, S. I. D.—Nov. 96.—800.

Litho., S. I. O., Calcutta.

No. 408-S 94.

INDEX
TO THE
INDIAN ATLAS
on the Scale of 1 Inch = 4 Miles
Shewing Work in hand on the
1st October 1896.

Scale 1 Inch = 256 Miles.
200 150 100 50 0 200 400

BAY OF BENGAL

Reg. No. 874, S. I. D.—Nov. 96.—585.

Litho., S. I. O., Calcutta.

No. 407-S. 94.

THE PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE.

528. The office remained under the charge of Colonel J. Waterhouse, S.C., throughout the year.

The services of two valued assistants have been lost by the retirement of Mr. H. L. Lepage, Head Assistant in the Lithographic Section, and Mr. B. Mackenzie, Head Printer in charge of the Zincographic Printing Section. The former had served in the Lithographic office since July 1871, and was a very hardworking and useful assistant in dealing with the varied work passing through the Lithographic Press. Mr. B. Mackenzie had even longer service than Mr. Lepage, having joined the office from the Ordnance Survey Office, Southampton, in 1868, and it is to his skill as a zincographer, his careful supervision and zealous performance of his duties that much of the success of photozincography in this office has been due. He was a man to be thoroughly depended upon, and his loss is to be much regretted.

On the retirement of Mr. Lepage, Mr. S. M. Coard, of the Engraving Office, was appointed to act as Head Assistant in the Lithographic Section and has done excellent service, especially in looking after the machinery. Mr. E. A. LeFranc was appointed to succeed Mr. B. Mackenzie as Head Printer, from the 1st May last, and took charge of the Normal Zinc Printing work, while Sergeant Vandyke took over the Lithographic Printing and has supervised it very satisfactorily. Mr. A. W. Turner, Photo-engraver, took furlough from the 9th July, and Mr. J. T. Meade, Assistant Photo-engraver, was appointed to act for him and has carried on the duties very satisfactorily. Rajendranath Palit, a draftsman, who had been attached to the Lithographic Section for 31 years, died during the year.

Personnel.

Colonel J. Waterhouse, Assistant Surveyor General in charge.

NORMAL ESTABLISHMENT.

LITHOGRAPHIC AND PRINTING DIVISION.

Lithographic Drawing Section.

Mr. H. L. Lepage, Head Assistant, up to 3rd August 1896.
" S. M. Coard, Officiating Head Assistant, from 4th August 1896.
" E. Dowling, Head Draftsman.
Babu Ambica Churn Mukerji, Draftsman.
Munshi Abdool Hamid, Examiner.
1 Apprentice, 28 draftsmen and 6 colorists.

Lithographic and Zinc Printing Section.

Mr. B. Mackenzie, Head Printer, up to 30th April 1896.
" E. A. LeFranc, Head Printer, from 1st May 1896.
" D. Deas, Chromo-litho Printer.
" S. U. Ravenscroft, Assistant Chromo-litho Printer.
" J. B. Mackenzie, Assistant Zincographer, up to 30th April 1896.
" C. Andrews, Machine Printer.
2 Machine printers, 1 apprentice, 15 litho and zinc printers, 9 machinemen, 17 spongemen, 40 pressmen, 1 paper wetter, 2 stonegrainers, 2 stone polishers, 4 zinc grainers, 1 inkgrinder, 1 engine-driver, and 1 fireman.

Type Section.

Mr. E. DePyvah, Head Printer.
12 Compositors, 3 typeprinters, 3 inkmen, 3 mates, 2 machine type printers, 2 machine inkmen, 1 impositor, 1 roller moulder and 1 boy.

PHOTOGRAPHIC AND GENERAL DIVISION.

Photographic, Negative and Printing Section.

Mr. J. Harrold, Photographer.
" C. J. Meade, Assistant Photographer.
" F. N. Murphy, Do.
Munshi Ismail Khan, Do.
" Habibul Hossain, Do.
5 Assistant photographers and 8 labourers.

Heliogravure Section.

Mr. A. W. Turner, Photo-engraver, up to 9th July 1896.
" J. T. Meade, Assistant Photo-engraver. (Officiating Photo-engraver, from 10th July 1896.)
" N. J. Gonsalves, Officiating Assistant Photo-engraver, from 10th July 1896.
1 Assistant Photo-engraver, 1 engraver, 1 Assistant engraver, 4 copperplate printers, 6 pressmen and 11 plate polishers.

Correspondence, Stores and Accounts Section.

Mr. R. George, Officiating Storekeeper.
Babu Kanny Lall Sen, Head Clerk and Accountant.
" Kedar Nath Ghose, Clerk.
" Gopal Chunder Mukerji, Clerk.
" Surja Kumar Banerji, Clerk.
" Rajani Kanta Chatterji, Clerk.
4 Clerks, and 1 paper-keeper.

CADASTRAL ESTABLISHMENT.

Photographic Section.

Mr. H. Haward, Head Photographic Assistant.
" L. Lagnier, Photographer.
" T. Lloyd, Photographer.
" J. Vieux, Assistant Photographer.
7 Assistant Photographers, and 10 labourers.

Zinc Printing Section.

Mr. E. A. LeFranc, Zincographer, up to 30th April 1896.
" F. R. Vandyke, Zincographer, up to 30th April 1896.
" J. B. Mackenzie, Zincographer, from 1st May 1896.
" P. Michael, Assistant Zincographer.
Babu Khetter Mohun Das, Clerk.
9 Zinc correctors, 9 zinc printers, 10 spongemen, 17 pressmen, 11 zinc grainers and 1 clerk.

529. The machinery has worked steadily during the year, with the exception of the large lithographic machine which was stopped for about a month on

account of the brake giving way. The engine and boiler were thoroughly cleaned and overhauled last Doorga Puja holidays under the immediate supervision of Mr. Coard. Considerable inconvenience is being felt at the entire stoppage of machine work, whenever the boiler has to be cleaned or stops working, and more especially on account of the want of water, for which we are entirely dependent on our steam pump. It would be desirable to provide a second boiler soon on this account and also so that in case of a break down of the present boiler, which has now been working for about 6 years, the new one would be ready to take up the work. With the mass of printing work now coming in all the year round, the stoppage of the engine would involve very serious loss and delay in turning out work and practically paralyse the office. A new lithographic printing machine for imperial-sized plates or stones will also soon be required in order to meet the heavy demands for printing-work at certain seasons of the year when there is extra pressure, and also to provide for more colour-printing being done.

530. The general abstract of work given in the table below shows a fairly large increase in nearly all the items, especially in subjects, and in the outturn of the Heliogravure Section.

General Abstract of Work done during the year 1895-96.

Classification.	Sheets of subjects.	Negatives and transparencies.	Photo-zincographic and Lithographic Printing. Photo-transfer Prints.	Zinc Plates transferred.	Zinc Plates Printed.	Stones.	Pulls.	Number of Copies. Coloured.	Uncoloured.	Total.	Type Printing. Pages or items.	Pulls.	Copies.	Silver and other Printing. Silver Prints.	Blue Prints.	Heliogravure and Electrotyping. Heliogravure Plates.	Heliogravure Prints.	Photo-Blocks.	Electrotypes.	Value. R a. p.
Departmental Maps, etc.	676	968	1,020	319	355	86	226,603	31,885	173,609	205,494	11,915	1,271,557	668,795	69	2,043	18	2,018	...	17	71,169 14 3
Cadastral Maps	4,874	3,696	3,696	4,921	4,921	...	125,584	...	111,430	111,430	...	...	...	...	...	...	...	...	...	62,244 10 9
Extra-Departmental Maps and Plans, etc.	1,470	1,292	1,144	512	785	443	5,14,436	89,896	541,237	631,133	...	...	...	458	499	126	54,370	5	...	86,364 6 6
Totals	7,020	5,956	5,860	5,782	6,061	529	862,623	121,781	826,276	948,097	11,915	1,271,557	668,795	527	2,542	144	56,388	5	17	2,19,778 15 6
Totals of 1894-95	5,908	4,779	4,624	4,759	5,244	433	894,286	144,520	777,322	921,882	11,679	1,291,041	652,175	652	3,168	85	49,675	6	7	2,06,926 11 0
Differences	+ 1,112	+ 1,177	+ 1,236	+ 1,023	+ 817	+ 96	− 31,663	− 22,739	+ 48,954	+ 26,215	+ 236	− 19,484	+ 16,620	− 125	− 626	+ 59	+ 6,713	− 1	+ 10	+ 12,852 4 6

531. The printed outturn of the Lithographic and Zincographic presses and machines, as reckoned in pulls, was 862,623, or 31,663 less than last year, but the number of copies was greater by 26,215. The number of plates and stones printed was very much larger and the decrease in the number of pulls was partly due to the stoppage of the large litho-machine and also to the preponderance of sheets of the cadastral surveys of the North-Western Provinces of which only a very small number of copies are printed. The number of cadastral sheets printed off was 919 more than in the previous year. The number of sheets of Departmental work was rather less than last year, but the Extra-departmental work again shows a considerable increase. In this work also there is a decrease in the number of pulls but a large increase in the number of copies. This is due to the preponderance of small work or of subjects of which only a small number of copies are required and such jobs show a tendency to increase, so that the actual work done is not fully represented by the printed outturn. In the Type-Printing Section the number of pages or items set up has increased and so has the number of copies, but the number of pulls is less.

532. The work of the Silver-Printing Section shows a slight decrease, both in silver and blue prints, though the section has been fully employed during the year. In the Heliogravure Section a very large increase is shown, both in the number of plates etched, which amounted to 144, or 59 more than last year, and also in the number of prints, which shows an increase of 6,713. The number of plates electro-typed also increased by 10.

533. The departmental publications of the year have been unimportant. It is to be regretted that the third edition of the 32-mile map of India is still

unpublished pending the complete settlement of the North-East and North-West Frontier boundaries. Sheets 1 and 4 have again been largely revised and corrected and further corrections are still necessary to bring them up to date, with the most recent additions in Chitral, the Pamirs and the Burma-China Frontier. For the same reason no further progress has been made with the new chromolithographed map of Afghanistan which was noticed in last year's report. A set of colour stones were made for the Canal Map of India on the scale of 1 inch = 32 miles.

534. Among the Provincial maps a reissue, with corrections, of the skeleton map of the Punjab on the scale of 1 inch=32 miles may be noted, also Punjab and Kashmir in 4 sheets on the scale of 1 inch=16 miles with the hills printed in brown from photo-transfers. The map of the North-Western Provinces and Oudh, 1 inch=16 miles, was completed as far as material was available. Three of the district maps on the scale of 1 inch=2 miles, specially prepared for the Government of the North-Western Provinces, have been in hand during the year. Districts Mirzapur in 6 sheets and Naini Tal in 2 sheets were printed and district Garhwal was transferred but not printed. The following district maps on the scale of 1 inch=4 miles taken from the engraved Atlas sheets have been under preparation during the year, *viz.*,—Champaran, Dacca, Gaya, Jalpaiguri and Native State of Cooch Behar, Kasi and Jaintia Hills, Lakhimpur, Murshidabad and Simla, and new issues have been made of the following: Cuttack (2nd edition), Hazaribagh, Howrah, Jessore, Khulna, Muzaffarpur, Noakhali, Nowgong, Puri, Raipur and Rungpore.

535. The number of sheets of standard maps of the Topographical and Revenue Surveys on the 4-inch, 2-inch, 1-inch, half-inch and quarter-inch scales which have been in hand either for reprinting or publication, was 332; 119 zinc plates and 3 stones were printed; 68 sheets were printed off on the 1-inch scale during the year, including 7 of Bengal, 15 of Bombay, 7 of Lower Burma, 13 of Upper Burma, 4 of Central India and Rajputana, 1 of Central Provinces, 13 of the Indus Riverain Survey, 1 of Madras, 2 of North-Western Provinces and Oudh. Of the Lower Burma Survey on the scale of 4 inches=1 mile, 15 sheets and of the Konkan Survey 1 sheet were printed. Of the North-Western Provinces on the scale of 2 inch=1 mile 8 sheets were printed off. Of the maps of the North-Eastern and South-Eastern Frontiers on the scale of 1 inch=4 miles, 8 sheets and 2 sheets respectively were printed and of the North-Eastern Frontier on the scale of 1 inch =2 miles 2 sheets were printed. Of the South-Eastern Frontier on the scale of 1 inch=8 miles one sheet was issued.

536. The City and Cantonment plans printed off and published during the year include the map of Calcutta and Environs in 4 sheets on the scale of 3 inches=1 mile, referred to in last year's report; Naini Tal, in 5 sheets, on the scale of 40 inches=1 mile; maps of Dharwar City and Environs and of Multan City and Environs, were reproduced but not printed. A map of Delhi Cantonment and Civil Station on the scale of 10 inches=1 mile was lithographed for the Chief Engineer, Public Works Department, Punjab.

537. Among the miscellaneous maps and plans the most important item is 32 sheets of the Madras Forest Survey on the scale of 4 inches=1 mile. A map showing the path of the total solar eclipse of January 21st, 1898, was prepared and printed.

538. The extra-departmental work again shows a very considerable increase in nearly all items over last year. The number of subjects dealt with was 1,470 against 1,256 of the previous year; the total number of complete copies or impressions was 631,133 against 571,243. The total value of the extra-departmental work done in all sections was R863,64-6-6, against R76,534-11-0 of the previous year.

539. The photo-zincographed plates illustrating Dr. Führer's report on the Great Jaina stupa at Mathura and those for Part II of Mr. Smith's Report on Fatehpur Sikri, referred to in last year's report, were printed off. A commencement was made with the plates of Part III and 46 plates were transferred to zinc. Two important new railway maps were lithographed for the Government of India, Public Works Department (Railways), *viz.*,—India showing the distribution of railways in relation to population and India showing the distribution of railways in relation to annual rainfall. A large amount of work has been done for the Calcutta Municipality in connection with the new drainage scheme.

For the military authorities several more of the maps of country 10 miles round cantonments have been prepared or reprinted, including Peshawar, Rawalpindi, Bareilly, Meerut, reprinted, and Jullundur, Chakrata, Dera Ismail Khan, Abbottabad, Mardan, Kohat, Baksa (Duars), Tezpur, Rangoon, Sialkot, Edwardesabad, Quetta, and Cuttack, newly issued. For the Geological Survey a geological map of Naini Tal on the scale of 10 inches to the mile, also a map of district Bellary based on the quarter inch atlas sheets were chromo-lithographed but not printed off. A new postal map of Assam, in 2 sections on the scale of 1 inch=8 miles, was lithographed and printed for the Postal Department, also a chart of the world on Mercator's projection in two sections on the scale of 1 inch=400 miles. The work done for the Meteorological Department has been steadily increasing and amounted to 35 zinc plates and 47 stones printed, with 158,210 pulls and 245,345 complete copies. A new daily weather chart of the Bay of Bengal was prepared and printed for issue during the monsoon months. The work sent in by the Superintendent of Government Printing is also very largely increasing, and very much of it, consisting of diagrams and sketch maps illustrating Government proceedings, scarcely gives a proportionate outturn in pulls and copies for the amount of work done in preparing the drawings for lithography, especially if they are more or less elaborate.

540. It was noticed in last year's report that the maps of Penang and Province Wellesley on the scale of 5 inches=1 mile were being reproduced in this office; 40 plates including the title sheet of the Penang Survey were printed off.

541. Seventy-four zinc plates, including 31 plates reprinted, of maps prepared by the Royal Survey Department of the Siamese Government, including 10 sheets of the outline map of Siam, 31 sheets of vernacular district maps and 2 sheets of a general map of Siam on the scale of 1:2,280,960, or about 1 inch=36 miles, have been printed during the year.

542. In the Heliogravure Section the number of plates photo-etched was 51 and the number of copies printed 5,936 more than last year. As usual the work has been almost entirely extra-departmental and includes 12 plates of the Technical Art Series for 1895 printed off, 15 plates of the series for 1896 photo-etched and 6 plates printed off. Twelve plates of fishes and crustacea illustrating the zoology of the Royal Indian Marine Steamer *Investigator* were photo-etched and printed off. A series of 26 plates illustrating a report on the Chin Hills was prepared for the Superintendent of Government Printing, Rangoon, and printed off. Twenty-seven plates of views, etc., illustrating the report of the Pamir Boundary Commission, were photo-etched but not printed. Twelve plates of reproductions of a selection of Signor Beato's Views of Lucknow at the time of the Mutiny were photo-etched and printed off to illustrate Mr. G. W. Forrest's book on the Mutiny at Lucknow. Two plates illustrating the action of cobra venom upon the blood were photo-etched from chalk drawings on glass and printed in three colours, red, blue and brown, very successfully, and the method, which was described in last year's report, and is again referred to in the appendix (p. xx), appears to be really useful for work of this kind. The frontispiece and the two plates illustrating Mr. G. P. Tate's report on the Baluch-Afghan Boundary Commission are fair specimens of the work now turned out. The heliogravure process is beginning to be largely utilised and more work has come in than could be easily undertaken. If the increase continues, more printing presses or machines will be required to meet the demands. No further progress has been made with the block process as it is found that the blocks require a great deal more work in proportion to their size and value than the photo-etched plates do, while the best results that can be attained without special appliances and machinery are comparatively inferior.*

* Colonel Waterhouse reports that all his principal assistants, Messrs. H. L. Lepage (retired), S. M. Coard, B. Mackenzie (retired), E. A. LeFranc, D. Deas, Sergeant Vandyke, J. B. Mackenzie and Mr. E. DePyvah in the Lithographic, Zincographic and Type Printing Sections, and Messrs. H. Haward, A. W. Turner, J. Harrold, R. George, L. Lagnier, and T. Lloyd in the Photographic Section, have worked well. Amongst the junior assistants and apprentices the following are commended :—

Messrs J. T. Meade, C. J. Meade, E. Dowling, S. V. Ravenscroft, P. Michael, C. Andrews, F. N. Murphy, N. J. Gonsalves, I. Vieux and J. DeSilva. In the Lithographic Drawing Section, Babu Ambica Churn Mookerji, Munshi Abdool Hamid, Abdool Hakim, Munshi Elahi Bux, Babu Dina Nath Das, and most of the other assistants have done well. In the Photographic Section the following native assistants may be specially mentioned as doing good work :—Mahomed Ismail Khan, Habibul Hossain, Abdool Ruhman, Ambica Churn Bhuttacherji, assistant photographers, and Azizoor Ruhman, native engraver, also Aghore Nath Sircar, copper-plate printer. In the Correspondence and Account Section Babu Kanny Lall Sen has conducted the duties of head clerk and accountant very satisfactorily. Babus Kedar Nath Ghose, Gopal Chunder Mukerji, Surja Kumar Banerji, Rajani Kanta Chatterji, Nogendra Nath Mukerji and other native clerks have given satisfaction.

MAP RECORD AND ISSUE OFFICE.

Personnel.

Mr. T. A. Pope, Officiating Deputy Superintendent, 1st grade, in charge, from 10th July 1896.
„ C. F. Erskine, Deputy Superintendent, 2nd grade, in charge, up to 23rd March 1896.
„ A. E. Spring, Deputy Superintendent, 2nd grade, in charge, from 24th March 1896 to 9th July 1896.
„ F. A. D'Rozario, Head Clerk, Mr. H. R. Vallis, Map Curator, and 16 other clerks.

543. During the year under review the general superintendence of this office has been held by Messrs. T. A. Pope, C. F. Erskine and A. E. Spring, respectively.

544. The number and value of maps issued during the year are as follows :—

Maps issued.	Number.	Value.
		R
General maps to Government officials	77,936	59,950
Ditto to India Office, London	3,416	4,569
Ditto to Agents	1,054	1,253
Ditto to private individuals	9,142	12,081
TOTAL .	91,548	77,853
Cadastral maps to Government officials	108,868	38,849
GRAND TOTAL .	200,416	1,06,702

545. There has been a large reduction in the number of maps issued to Government officials, but their value exceeds that of last year owing to the demand for maps of higher value being made; in the case of issues to private individuals, however, the number and value are both higher than they were in the year 1894-95. The number and value of the maps issued during the preceding year were 234,226 and R1,10,956 respectively, showing in the year under report a decrease of 33,810 in number and R4,254 in value.

546. The amount realized from the cash sale of maps was R23,507, *viz.*, R12,081 from private individuals, R1,099 from agents, and R10,327 from Government officials, showing a small increase of R168 on the cash receipts of the previous year.

547. In the Revenue Section 689 applications were received for extracts from original records of the Revenue Surveys, and 2,870 for certified copies of village plans, tracings and traverses, which were all supplied at a charge of R8,650.

548. The details of work are given in the following statement, and show a slight increase over last year's figures :—

Details.	Number.
Applications received for maps	5,077
Letters issued in reply	3,697
Cash and credit map sale bills	1,666
Invoices and receipts issued for published maps	2,446
Ditto ditto cadastral maps	233
Ditto ditto extracts from original records . .	344
Packets, parcels and local despatches	4,716
Ditto received in office	783
Packages despatched by rail and steamer	343
Ditto received ditto	115
Maps coloured for sale and issue	28,158
Ditto for other departments	3,271

A list of the maps and charts published during the year will be found at page 105.*

* Mr. Pope reports that Mr. D'Rozario has continued to perform his duties, which are somewhat arduous, to his entire satisfaction. Mr. Vallis has, as usual, rendered good service as Map Curator, and Messrs. Hazra and D'Cruz and the other assistants have also worked well.

MATHEMATICAL INSTRUMENT OFFICE.

Personnel.

Colonel M. W. Rogers, R.E., Assistant Surveyor General, in charge from 15th November 1895.
Mr. T. A. Pope, Officiating Assistant Surveyor General, in charge up to 14th November 1895.

Workshop Branch.

Mr. T. Bolton, Mathematical Instrument Maker.
Mr. T. R. Theakston, Assistant Mathematical Instrument Maker.

Store Branch.

Mr. M. C. Belletty, Instrument Store Keeper.
Babu Womesh Chunder Chowdury, Material Store Keeper.

Office Establishment.

Mr. W. Campagnac, Head Clerk.
" W. R. Tulloch, 2nd Clerk.
Six clerks and two temporary clerks.

549. The charge of this office was held by Mr. T. A. Pope from the beginning of the year under report until the 15th November 1895, when he was relieved by Colonel Rogers on his return from furlough, who held charge during the remainder of the year.

550. All figures in this report refer to the financial year, *i.e.*, from 1st April 1895 to 31st March 1896. During this period the number of serviceable instruments received into store was 89,022 and their value was R2,88,055, whilst the number of those issued from store was 96,673, valued at R3,54,890. In the subjoined statement these figures are compared with those of the preceding year, and it will be seen that as regards receipts of instruments, there has been a very small increase in the number, whilst their value has decreased by nearly a lakh of rupees. The number of instruments issued is considerably larger, and their value is in excess of last year's issues by more than a lakh of rupees.

	1894-95.	1895-96.	Increase.	Decrease.
Number of instruments received . .	88,591	89,022	431	...
Value of ditto . . *R*	3,80,703	2,88,055	...	92,648
Number of instruments issued . .	71,875	96,673	24,798	...
Value of ditto . . *R*	2,40,818	3,54,890	1,14,072	...

From this table it will be seen that the number of serviceable instruments in store has decreased by 7,651 and their value by R66,835.

551. In the following statement are shown the principal sources from which the serviceable instruments were received:—

Sources of Receipt.	Number.	Value.
		R
From England on indent	10,979	1,03,167
By purchase in the local market . . .	15,505	41,264
Manufactured in the workshop	25,779	29,813
Returned to store by public officers . . .	32,934	30,931
From repairable stock after repair . . .	3,819	82,814
From other sources	6	66
Total .	89,022	2,88,055

The number of the instruments received from England on indent is less than half that of the preceding year, and the value has decreased by a lakh and a quarter of rupees. This is mainly due to the fact that no indents for levels and theodolites have been made for two years, all such instruments having been

supplied from the repairable stock, which is being put into serviceable order by the establishments sanctioned for their repair. The value of the instruments purchased in India has increased by a small amount in consequence of the considerable increase in the number and value of instruments issued, which increase was 25,000 in number and R1,14,000 in value. The number and value of the instruments manufactured in the workshops is greater than last year. Their class and value will be found in Table C in the Appendix.

552. The number of instruments taken from the repairable stock and rendered serviceable for issue is larger in number than last year, and their value, when repaired, is in excess of that of either of the last two years. During the year under report the office has received into store 11,574 repairable instruments valued at R77,323, compared with 9,062 instruments valued at R66,198 in the previous year. The total number of instruments from the repairable stock which were rendered serviceable was 3,819 and their original value was R52,938. These were repaired in the workshops at a cost of R29,876, and transferred at the enhanced value to the serviceable stock. The repairable stock has thus been increased by 7,755 instruments, valued at R24,385. This result is due to large returns to store by public officers, which are so large as to still altogether exceed the best efforts of the workshop to reduce the number of repairable instruments, although, as shown above, the number and value of the instruments rendered serviceable has considerably increased this year, but it is to be expected that when the new extra establishment for repairing theodolites is in full working order the value of the repairable stock on hand will begin to steadily decrease.

553. The conversion of old-pattern levels and theodolites alluded to in paragraph 670 of last year's report has been steadily continued, and during the year under report 60 levels of obsolete patterns have been converted into serviceable instruments and issued.

554. During the year the number of indents complied with was 1,313, being 165 more than in the previous year. They were of the usual description, from all parts of India.

555. The cash payments for charges under R50 amounted to R42,753 in the year under review. This is an increase of R8,863 on last year's figures and represents a very large amount of labour and responsibility devolving on the Office.

556. The chief event to be recorded is the assembling of a Committee by order of the Surveyor General to examine and report upon the repairable stock of the Office, and to advise on the best way of utilizing and disposing of it. This accumulation of repairable instruments has been going on for many years and is mainly due to the large expansion of the Public Works and other departments in India which has caused an increase in the number of instruments returned to store in a repairable condition after use, and has at the same time, by increasing the demand for current repairs, largely employed the workshops in this kind of work and diminished their power of repairing the instruments in stock.

557. This gradual increase has been represented in all the reports for many years, and in 1887 the Government of India sanctioned an extra establishment, costing R150 per mensem, to help the office, which establishment was made permanent in 1890, and again in 1889 a further grant of R120 per mensem was sanctioned to be employed in converting levels of obsolete patterns into serviceable instruments, and again in 1895 a further grant of R220 per mensem was sanctioned to further increase the establishment for converting levels. Since the commencement of these grants 271 levels and 53 theodolites have been converted and issued, and all indents on England for levels have been discontinued.

558. The Committee found that the repairable instruments could be divided into three classes: 1st, those that are in fair order and worth the cost of repair or conversion; 2ndly, those (chiefly large-sized theodolites) which are in fair order, but for which there is no demand, and which are therefore not worth repair; and 3rdly, a large quantity of obsolete and entirely useless instruments which, in most cases, are repairable only in name, and of little or no use when repaired. In the first case they recommended a temporary increase to the workshop establishment to repair and convert the instruments of the 1st class, chiefly theodolites. In the second case they recommended that the surplus instruments should be advertised

and sold if possible, and in the third case they recommended that the Superintendent should be empowered to condemn and break up everything that was obsolete and not likely to be issued if repaired. All these recommendations were approved of by the Government of India, and a grant of R600 per mensem for five years has been sanctioned to entertain an extra establishment for the repair and conversion of theodolites, etc., and a yearly sum of R3,000 to defray the expense of castings and other materials required. This establishment will enable the office to reduce the indents on England, and as a fact no theodolites have been indented for since 1895 and no levels since 1894. The value of the English indents for the last five years is shown in the accompanying table, which gives some indication of the saving which is being produced by the utilisation of the extra grant for repairing instruments:—

Year.	Value of English Indent.
1892-93	£8,972
1893-94	£13,875
1894-95	£12,981
1895-96	£5,208
1896-97	£5,079

559. Table A (in the Appendix) shows the amount of debits against various offices and departments for instruments supplied and for work done. It also exhibits the credits for all instruments and materials returned into store. The value of the issues and repairs executed on book debit was R3,29,853, being R1,06,191 greater than last year. This amount includes the value of instruments purchased with the extra-departmental grant of R45,000, out of which R34,287 was expended. The credits for instruments returned into store amounted to R1,08,962, which is an increase on the previous year. The grand total of the value of supplies, including the cash sales, is R3,72,606, or considerably more than a lakh of rupees more than last year or the year previous. This increase is probably due to the extension of public works and railways.

560. The number of principal instruments repaired in the workshops is 3,804 or about 300 more than last year. The total number of instruments of all kinds repaired amounts to 4,808 or 400 in excess of last year.

561. It will thus be seen that during the year under review there has been a very much larger demand for instruments from the stores than in the two previous years, and that the actual work of all kinds done in the workshop has been more than in the previous year, the total value of all work done in 1895-96 being R84,883 against R75,313 in 1894-95. Thus both the store and office branches and the workshops are to be credited with an outturn which compares favourably with former years.

562. The profit and loss account of the workshop will be found in the Appendix, the result of the operations showing a nominal profit of R3,925, from which it appears that the rates for work are fairly correct.*

* Colonel Rogers reports that Mr. Bolton, the Mathematical Instrument Maker, has continued to manage the workshops and supervise the store branch with his usual zeal and ability, and has done his utmost to organise the new establishments lately sanctioned. Mr. Theakston, the Assistant Mathematical Instrument Maker, has also given entire satisfaction and carried on his duties efficiently. He is an intelligent and reliable officer.

In the correspondence and store branch, Messrs. Campagnac, Belletty, and Tulloch are well reported on, and among the native assistants, Babu Durga Churn Ghose, Gossain Das Roy, Shib Chunder Ghose and Narain Chunder Banerjee, clerks, and Umesh Chunder Chowdry, material store-keeper, are selected for special mention.

II.—TRIGONOMETRICAL BRANCH OFFICE, DEHRA DUN.

563. For the first half of the year Lieutenant-Colonel St. G. C. Gore, R.E., was in charge of the office, and on his proceeding on furlough in March 1896, Captain S. G. Burrard, R.E., was appointed to officiate for him, but as he was unable to undertake the duties for two months, Mr. J. Eccles, M.A., carried on the Superintendent's work.

Personnel.

Superintendence.

Lieut.-Colonel St. G. C. Gore, R.E., Superintendent, Trigonometrical Surveys.
Captain S. G. Burrard, R.E., Officiating Superintendent, 2nd grade, in charge from 18th May to the end of September 1896.
Mr. J. Eccles, M.A., Deputy Superintendent, 1st grade, in charge Computing Party; and in charge of Trigonometrical Branch Office from 5th November to 4th December 1895, and from 27th March to 17th May 1896.

(1) Computing Section.

Mr. H. W. Peychers, Extra Assistant Superintendent, 2nd grade.
" A. D. L. Christie, Extra Assistant Superintendent, 3rd grade.
Babu Amba Prasad and 8 other computers, 2 copyists and 2 writers.

(2) Printing Section.

9 compositors and 2 distributors.

(3) Photo-zincographic Section.

Mr. J. S. Manuel, Zincographer, from 1st June to 27th July, 17th August to 6th September 1896.
" G. A. LeFranc, Assistant Zincographer, Officiating Zincographer, up to 31st May 1896, 28th July to 16th August, 7th September to 30th September 1896.
2 Photographers, 6 plate correctors, 5 retouchers, 4 zinc printers, 12 assistant zinc printers, 1 accountant, 1 storekeeper and 1 despatcher.

(4) Correspondence Section.

Mr. J. Burbridge, Head Clerk, and 3 clerks.

(5) Stores, Workshops and Observatories Section.

1 writer, 1 head artificer, and 3 artificers.

(6) Drawing Section.

Mr. C. H. McA'Fee, Extra Assistant Superintendent, 3rd grade.
4 draftsmen, 1 surveyor, 3 assistants and 8 apprentice draftsmen.

(7) Solar Photographic Section.

Mr. C. F. Guthrie, Assistant Solar Photographer.

(8) Training School.

Khan Sahib Abdul Guffar, Surveyor.

564. During the year the alterations to the office buildings, mentioned in paragraph 678 of the last report, were finished. The work is now carried on under much more favourable circumstances than formerly.

565. During the year the Government sanctioned a small grant for the training of sub-surveyors to meet the demand of the various field parties. The school was started in May 1896 under Khan Sahib Abdul Guffar as instructor. It is hoped that the scheme will be successful and that in the near future its scope will be greatly extended. At present eight pupils are under instruction, and will shortly be sent to fill vacancies in field parties.

566. The office is divided into the following sections :—

(1) Computing.	(5) Stores, workshops, and observatories.
(2) Printing.	(6) Drawing.
(3) Photo-zincographic.	(7) Solar Photographic.
(4) Correspondence.	(8) Training School.

(1) Computing Section.

567. In addition to the five instalments of field records which were received during the year and stored as usual, a good deal of work was entailed on this section in taking out from the packing cases, where they had been stored during the alterations to the office buildings, the field-records and library books and re-arranging them. In all 20 requisitions for data and 14 indents for forms were complied with. The computations for the Synoptical volume of the North-East Longitude Series were proceeded with, and those of the Indus Delta triangulation were finally reduced. The adjustment to mean sea-level of spirit-levelled heights for pamphlets Nos. 7 and 8 (revised edition) and No. 9, and the reduction of Chitral triangulation were completed. A considerable amount of help was afforded to the Astronomical Parties in the reduction of Electro-Telegraphic Longitude observations, and other computations of a miscellaneous character were done. The preparation of press copy and examination of press

proofs were carried on as hitherto ; the outturn of work from these is given in the next section. Two preliminary charts of Monghsat Secondary Series, 2 of Eastern Frontier Series, 1 of the lower portion of Singi Meridional Series, and data for two other charts were compared and examined. The work in connection with the protection of stations was conducted as usual. Twenty-four districts out of 347 omitted to submit reports. The two stations marking the ends of the Dehra Dun base-line were inspected by an officer of this department; one was put into thorough repair and the other was almost entirely rebuilt. Thirty-four candidates for the Provincial service of the Survey of India were examined. The meteorological observations were continued as usual.

(2) *Printing Section.*

568. The following is the progress made :—

(*a*) Pamphlet of spirit-levelled heights, Calcutta, published.
(*b*) Pamphlet of spirit-levelled heights, No. 9, Orissa and the Northern Circars, published.
(*c*) Pamphlet of spirit-levelled heights, No. 8, Central Provinces and Orissa (revised edition), in the hands of the binder.
(*d*) A pamphlet of instructions on Magnetic observations, finished.
(*e*) Hand-book of Topographical Branch (second edition) finished, leaving only the Index to complete the book.
(*f*) Tidal volume, 36 pages printed.
(*g*) Synoptical volume of the Great Arc Meridional Series, section 8° to 18°, 24 pages printed.

In addition to the above, a large amount of work was done in printing the letter-press for charts, headings and foot-notes for maps, and professional forms for the department.

(3) *Photo-zincographic Section.*

569. Mr. Manuel was absent for nine and a half months on account of ill-health. Mr. LeFranc officiated for him.

There was no extra work, such as that caused by the Chitral Expedition, thrown on this section during the year. The usual routine of map publication was carried on, and no arrears now remain.

(4) *Correspondence Section.*

570. This has been conducted as usual.

(5) *Stores, Workshops, and Observatories Section.*

571. This has been conducted as usual.

(6) *Drawing Section.*

572. Sickness during the latter half of the year among the draftsmen and the resignation of one man tended to retard the work very considerably. The sheet on the scale of 1 inch to 16 miles, which was in hand last year, was completed but could not be published owing to receipt of new material. The country surveyed by No. 18 Party was inserted on one of the Punjab standard sheets, and the sheet forwarded to Calcutta for publication. As the mapping of No. 18 Party was very much in arrears, assistance was rendered by this section in preparing the 4-inch sheets for reduction to half scale, and in extracting the *mauza* areas from 22 of the 4-inch sheets. The outturn will be found fully detailed in the appendix.

(7) *Solar Photographic Section.*

573. Mr. Guthrie was absent from sickness for over a month. The work of this section was conducted as usual.

(8) Training School.

574. Eight pupils were entertained and instructed in topographical surveying as far as possible, but the lateness of the season interfered a great deal with the progress made.

575. The offices were inspected in April and July 1896 by the Surveyor General, who was quite satisfied with the working of the several sections.*

III.—DRAWING OFFICE, SIMLA.

576. Colonel Holdich re-assumed charge of this office on his return from the Pamir Boundary Commission Survey about the end of October 1895, but on his leaving Simla on the 19th December the charge was made over to Mr. T. H. Rendell, the senior Assistant, Mr. G. W. E. Atkinson, being absent on privilege leave. On his return to duty in March, Mr. Atkinson again assumed the charge and held it during the remainder of the year.

Personnel.

Colonel T. H. Holdich, C.B., C.I.E., R.E., Superintendent, 1st grade, in charge.
Mr. G. W. E. Atkinson, Assistant Superintendent, 1st grade.
„ T. H. Rendell, Extra Assistant Superintendent, 4th grade.
„ W. J. Cornelius, Extra Assistant Superintendent, 5th grade.
„ F. E. Warde, Sub-Assistant Superintendent, 2nd grade.
„ F. Rozario, Surveyor.
„ H. Sindon, draftsman.
Munshi Jafir Khan, draftsman.
Mr. W. Manly, draftsman, and three other draftsmen.

577. The office was inspected by the Surveyor General in July.

578. Intimation having been received that an additional storey will be built over the rooms now occupied by this office during the ensuing winter, arrangements have been made to remove the Simla Drawing Office into the building known as "Claremont" early in October 1896.†

IV.—FOREST SURVEY BRANCH OFFICE, DEHRA DUN.

579. The head-quarters offices of the Forest Survey Branch at Dehra Dun remained throughout the year under the direct supervision of Mr. W. H. Reynolds. The following branches of work were dealt with:—

i. Correspondence and accounts of the several provincial forest survey detachments.
ii. Final computations of the several field detachments and areas.
iii. Up-keep of the Forest Department map records of the several provinces under the Government of India.
iv. Compilation and drawing of special maps for the Forest Department.
v. Training of surveyors.

580. The map records of the forests in the several Provinces under the Government of India as well as Madras have been posted up and all new tracts gazetted as State forests have been located on existing maps. Under this head might be noted the comparison of four taluk maps in Berar, the forests of which are notified in the local Gazette field by field (on the Bombay system) and consequently their identification is a tedious process; the posting to date of the catalogue of forest maps and classifications in portfolio form of forest maps received in the Forest Survey Office; the compilation of district maps of the Central Provinces for the Inspector General of Forests showing the distributions of forest areas; the abstract of forest notifications from the several Provincial Gazettes and the systematic arrangements of these in their respective volumes. This branch of the work of keeping and posting the forest map records of the several provinces of the Government of India has increased so considerably

* Mr. Eccles reports very highly of the work done by his assistants, Messrs. Peychers, Christie, McA'Fee and LeFranc, and speaks well of the computers.
The Superintendent reports very favourably of the assistance rendered him by Messrs. Christie and McA'Fee.
The correspondence office has carried on its work satisfactorily during the year.
† Colonel Holdich reports that his assistants have worked well during the year under review and have contributed to a very satisfactory outturn.

of late years, that it has become necessary to revise the system of keeping these records.

581. For the several Provincial Forest Departments, a vast amount of map drawing has been got out of hand during the year. Twenty-two special maps on various scales, chiefly for forest working-plans, were published during the year; two were in the press and thirteen were in hand. Of the 4-inch standard sheets of forest tracts surveyed by the Forest Branch, 105 were published, 72 sent to press and 132 in hand.

582. A large amount of miscellaneous work was also done during the year, included in which might be noted the colouring of 2,430 printed maps, and the preparation of 100 tracings for various Forest and District officers. Two thousand one hundred and ninety-six maps on various scales were cut up and mounted in book form for forest and other purposes and the information regarding the distribution of forest was added to 91 printed map sheets.

583. During the year 25 new men were instructed in the use of the theodolite and plane-table.*

* The Superintendent speaks highly of the work done by Mr. Descubes, who performs with credit any duty that may be required of him, and is deserving of special commendation. Mr. Watson is also favourably reported on.

Of the Native Establishment, Babus Kali-Kantha Kar, Badri Dutt, Bimala Charan Some, Tulsi Ram and Mahomed Hussain are deserving of special mention.

LIST OF MAPS AND CHARTS PUBLISHED DURING THE YEAR 1895-96.

Title.	Scale.	Number of sheets.	Remarks.
Atlas of India.	In. M.		
Sheet No. 14	1=4	1	With additions to 1892.
Sheet No. 29	1=4	1	With additions and corrections to November 1895.
Sheets Nos. 94, 103, 109, 114 and 121	1=4	5	With additions to 1895.
Sheet No. 48	1=4	1	With additions to 1893.
Sheets Nos. 79 and 108	1=4	2	With additions to 1894.
Sheets Nos. 21 S. E.; 26 N. E.; 38 N. W.; 49 S. W.; 50 N. W.; 60 N. E. and 114 N. W.	1=4	6	
Sheets Nos. 5 S. E.; 9 N. W.; 39 S. W. and 126 S. E.	1=4	4	With additions to 1895.
Sheets Nos. 35 S. E. and 69 S. W.	1=4	2	With additions to 1891.
Sheet No. 69 S. E.	1=4	1	With additions to 1892.
Sheets Nos. 25 S. W. and 69 N. W.	1=4	2	With additions to 1894.
Sheet No. 70 N. E.	1=4	1	With additions to 1889.
General Maps.			
Hazara and Isazai Expeditions, Sheets Nos. 1, 2 and 3 (District Hazara and Indus Valley)	2=1	3	
India	1=64	4	With additions to railways to 1896.
India (skeleton)	1=96	1	With additions and corrections to railways to March 1896.
India	1=128	1	Corrected to December 1895.
Provincial Maps.			
Gujarat (without hills)	1=16	1	
Punjab and Kashmir (with hills)	1=16	4	
Upper Burma (1894)	1=16	2	2nd edition, with corrections to boundaries to October 1895.
Skeleton map of the Punjab and surrounding countries	1=32	1	With additions and corrections to boundaries to March 1895.
District Maps.			
Twenty-four Parganas, Sheets Nos. 3 and 4	1=1	2	With additions to September 1895.
Rawalpindi, Sheet No. 1	1=1	4	With additions to railways to 1895.
Mirzapur	1=2	6	
Cuttack	1=4	1	2nd edition.
Faridpur	1=4	1	With additions and corrections to March 1896.
Hazaribagh	1=4	1	With additions and corrections to roads to April 1896.
Howrah	1=4	1	With additions and corrections to April 1895.

Title.	Scale.	Number of sheets.	Remarks.
District Maps—*continued.*	In. M.		
Jessore	1=4	1	With additions and corrections to 1896.
Khulna	1=4	1	With additions and corrections to May 1893.
Muzaffarpur	1=4	1	With additions and corrections to April 1896.
Noakhali	1=4	1	With additions and corrections to boundaries and roads to February 1896.
Nowgong	1=4	1	With additions and corrections to November 1893.
Puri	1=4	1	With additions to June 1896.
Raipur	1=4	2	With additions to March 1892.
Rangpur	1=4	1	With additions and corrections to roads to January 1894.
Standard Maps.			
Bengal.			
Sheets Nos. 269 and 270	1=1	2	Preliminary edition.
Sheets Nos. 8; 294; 295; 316; 317; 339; 349; 377 and 390	1=1	9	
Sheet No. 293	1=1	1	2nd edition.
Bombay.			
Sheets Nos. 176; 208; 209; 210; 245; 278; 309; 310; 311; 334; 335 and 336	1=1	12	
Burma (Lower).			
Prome and Toungoo Districts—Sheets Nos. 225 $\frac{N.E.}{4}$ and 225 $\frac{S.E.}{2}$	4=1	2	
Hanthawaddy District—Sheets Nos. 231 $\frac{S.E.}{4}$ and 279 $\frac{S.W.}{3}$	4=1	2	
Toungoo District—Sheets Nos. 272 $\frac{S.W.}{1}$ and 273 $\frac{N.W.}{2}$	4=1	2	
Districts Hanthawaddy and Tharawaddy—Sheets Nos. 277 $\frac{S.W.}{3}$; 278 $\frac{N.W.}{1}$ and 278 $\frac{N.W.}{3}$	4=1	3	
Hanthawaddy District—Sheets Nos. 278 $\frac{S.W.}{1}$; 278 $\frac{S.W.}{3}$; 279 $\frac{N.W.}{1}$; 279 $\frac{N.W.}{3}$; 279 $\frac{N.W.}{4}$ and 279 $\frac{S.W.}{2}$ (in one); and 279 $\frac{S.W.}{1}$	4=1	6	
Sheets Nos. 272; 273; 419; 423; 424 and 478	1=1	6	
Burma (Upper).			
Sheets Nos. 166; 167; 168; 213; 214; 215; 216; 259; 260; 261; 262 and 312	1=1	12	
Central India and Rajputana.			
Sheets Nos. 419; 450 and 483	1=1	3	

Title.	Scale.	Number of Sheets.	Remarks.
STANDARD MAPS—*continued.*	In. M.		
Central Provinces.			
District Nimar—Sheets Nos. 1 $\frac{\text{S.E.}}{1}$; 1 $\frac{\text{S.E.}}{2}$; 1 $\frac{\text{S.E.}}{4}$; 4 $\frac{\text{S.E.}}{2}$; 4 $\frac{\text{S.E.}}{4}$; 4 $\frac{\text{S.E.}}{3}$ and $\frac{\text{S.W.}}{4}$ (in one); 4 $\frac{\text{S.W.}}{4}$ and 5 $\frac{\text{N.W.}}{2}$ (in one); 5 $\frac{\text{N.E.}}{1}$; 5 $\frac{\text{N.E.}}{2}$; 5 $\frac{\text{N.E.}}{3}$; 5 $\frac{\text{N.W.}}{1}$; 5 $\frac{\text{S.W.}}{1}$; 5 $\frac{\text{S.W.}}{3}$; 5 $\frac{\text{S.E.}}{3}$; 6 $\frac{\text{N.E.}}{1}$; 6 $\frac{\text{N.W.}}{2}$ and 6 $\frac{\text{N.W.}}{4}$ (in one); 7 $\frac{\text{S.E.}}{1}$; 7 $\frac{\text{S.E.}}{2}$; 7 $\frac{\text{S.E.}}{4}$; 10 $\frac{\text{N.W.}}{3}$ and 4 $\frac{\text{N.E.}}{4}$ (in one); 10 $\frac{\text{N.W.}}{4}$ 10 $\frac{\text{S.W.}}{1}$; 10 $\frac{\text{S.W.}}{2}$; 10 $\frac{\text{S.W.}}{3}$; 10 $\frac{\text{S.W.}}{4}$; 11 $\frac{\text{N.W.}}{1}$; 11 $\frac{\text{N.W.}}{2}$; 11 $\frac{\text{N.W.}}{3}$ and 11 $\frac{\text{N.W.}}{4}$ (in one); 11 $\frac{\text{S.W.}}{1}$; 12 $\frac{\text{N.W}}{1}$ and 12 $\frac{\text{N.W.}}{2}$ (in one); 12 $\frac{\text{N.W}}{3}$ and 12 $\frac{\text{N.W}}{4}$ (in one); 12 $\frac{\text{S.E.}}{3}$; 13 $\frac{\text{N.E.}}{1}$ and 13 $\frac{\text{N.W.}}{2}$ (in one); 13 $\frac{\text{N.E.}}{3}$; 13 $\frac{\text{N.E.}}{4}$ and 13 $\frac{\text{S.E.}}{2}$ (in one); 13 $\frac{\text{S.E.}}{1}$; 13 $\frac{\text{S.W.}}{1}$ 13 $\frac{\text{S.W.}}{2}$; 13 $\frac{\text{S.W.}}{3}$; 13 $\frac{\text{S.W.}}{4}$ and 13 $\frac{\text{S.E.}}{3}$ (in one); 14 $\frac{\text{N.W.}}{2}$ and 15 $\frac{\text{N.W.}}{2}$ and part of 15 $\frac{\text{N.W.}}{4}$ (in one)	4=1	37	
Nimar and Hoshangabad Districts—Sheets Nos. 13 $\frac{\text{N.E.}}{2}$ and 13 $\frac{\text{N.W.}}{4}$	4=1	2	* 2nd edition.
Hoshangabad and Betul Districts—Sheets Nos. 19 $\frac{\text{N.E.}}{2}$† ; 19 N.E.*; 19 $\frac{\text{S.E.*}}{4}$; 20 $\frac{\text{S.E.}}{4}$; 21 $\frac{\text{N.E.}}{2}$; 26 $\frac{\text{N.E.}}{2}$; 26 $\frac{\text{N.E.}}{3}$ and 26 $\frac{\text{S.E.}}{1}$ (in one); 26 $\frac{\text{N.W.*}}{3}$; 26 $\frac{\text{N.W.}}{4}$; 26 $\frac{\text{S.E.}}{3}$; 26 $\frac{\text{S.W.*}}{1}$; 26 $\frac{\text{S.W.}}{2}$; 26 $\frac{\text{S.W.}}{3}$ 26 $\frac{\text{S.W.}}{4}$; 27 $\frac{\text{N.W.}}{4}$ and 27 $\frac{\text{N.W.}}{2}$ (in one); 27 $\frac{\text{N.W.}}{3}$; 27 $\frac{\text{S.E.}}{3}$; 27 $\frac{\text{S.E.}}{4}$; 27 $\frac{\text{S.W.}}{4}$; and 28 $\frac{\text{N.W.}}{2}$;(in one); 28 $\frac{\text{N.E.}}{1}$; 28 $\frac{\text{N.E.}}{2}$; 28 $\frac{\text{N.E.}}{3}$; 28 $\frac{\text{N.E.}}{4}$; 28 $\frac{\text{N.W.}}{1}$; 28 $\frac{\text{N.W.}}{4}$; 38 $\frac{\text{S.W.}}{2}$; 38 $\frac{\text{S.W.}}{3}$; 38 $\frac{\text{S.W.}}{4}$; 39 $\frac{\text{N.W.}}{1}$; 39 $\frac{\text{N.W.}}{2}$ and 39 $\frac{\text{N.W.}}{3}$	4=1	3	† 3rd edition.
Sheets Nos. 206, 207, 224, and 225 (in one) . . .	1=2	1	2nd edition.
Indus Riverain.			
Sheets Nos. 23; 24; 25; 26; 27; 41; 42; 43; 45; 46; 47; 48 and 68	1=1	13	
Madras.			
Sheet No. 23	1=1	1	
North-Western Provinces and Oudh.			
Sheets Nos. 17N.E.; 17N.W.; 17S.E.; 17S.W.; 18N.E.; 18N.W.; 18S.E. and 18S.W.	2=1	8	With additions and corrections to March 1896.
Sheets Nos. 17‡ and 187	1=1	2	‡With additions and corrections to March 1896.

Title.	Scale.	Number of Sheets.	Remarks.
STANDARD MAPS—*concld.*	In. M.		
Punjab.			
Gurdaspur District—Sheet No. 246 $\frac{\text{N.E.}}{3}$	4=1	1	
Gurdaspur and Kangra Districts—Sheets Nos. 246 $\frac{\text{N.E.}}{4}$; and 246 $\frac{\text{S.E.}}{1}$	4=1	2	
Kangra District—Sheets Nos. 264 $\frac{\text{N.E.}}{1}$; 264 $\frac{\text{N.E.}}{3}$; 264 $\frac{\text{N.E.}}{4}$; 264 $\frac{\text{S.E.}}{1}$; 264 $\frac{\text{S.E.}}{2}$; 264 $\frac{\text{S.E.}}{3}$; 265 $\frac{\text{N.E.}}{2}$; 265 $\frac{\text{N.E.}}{3}$; 265 $\frac{\text{S.E.}}{1}$; 265 $\frac{\text{S.E.}}{2}$; 265 $\frac{\text{S.E.}}{4}$; 285 $\frac{\text{N.W.}}{2}$;* 285 $\frac{\text{N.W.}}{4}$; 285 $\frac{\text{S.E.}}{1}$; 285 $\frac{\text{S.E.}}{3}$; 285 $\frac{\text{S.E.}}{4}$; 285 $\frac{\text{S.W.}}{2}$; 285 $\frac{\text{S.W.}}{3}$; 286 $\frac{\text{N.W.}}{1}$; 286 $\frac{\text{N.W.}}{3}$; 286 $\frac{\text{N.W.}}{4}$; 286 $\frac{\text{S.W.}}{1}$; 286 $\frac{\text{S.W.}}{2}$ 286 $\frac{\text{S.W.}}{3}$; 286 $\frac{\text{S.W.}}{4}$; 307 $\frac{\text{S.W.}}{2}$; 307 $\frac{\text{S.W.}}{4}$; 308 $\frac{\text{N.W.}}{2}$; 308 $\frac{\text{N.W.}}{4}$; 308 $\frac{\text{S.W.}}{1}$; 308 $\frac{\text{S.W.}}{2}$; 310 $\frac{\text{N.E.}}{4}$; 331 $\frac{\text{S.W.}}{3}$ and 332 $\frac{\text{N.W.}}{4}$	4=1	29	*With additions and corrections to boundaries and roads to 1895.
Kangra and Simla Districts—Sheet No. 310 $\frac{\text{S.E.}}{2}$ . .	4=1	1	
Patiala State Forests—Sheets Nos. 290 $\frac{\text{N.E.}}{3}$; 290 $\frac{\text{S.E.}}{1}$; 290 $\frac{\text{S.E.}}{2}$; 291 $\frac{\text{N.E.}}{2 \text{ and } 4}$ and 313 $\frac{\text{N.W.}}{1}$ (in one) . . .	4=1	4	
Amballa District—Sheets Nos. 313 $\frac{\text{N.W.}}{3}$; 313 $\frac{\text{N.W.}}{4}$; 313 $\frac{\text{S.W.}}{1}$; 313 $\frac{\text{S.W.}}{2}$ and 313 $\frac{\text{S.W.}}{4}$	4=1	4	
Simla District—Sheets Nos. 311 $\frac{\text{S.W.}}{1, 3 \text{ and } 4}$ (in one) and 312 $\frac{\text{N.W.}}{1 \text{ and } 2}$ (in one)	4=1	2	
Patiala State—Sheets Nos. 290 $\frac{\text{S.E.}}{4}$; 312 $\frac{\text{S.W.}}{1}$ and 312 $\frac{\text{S.W.}}{2}$	4=1	3	
Amballa and Simla Hill States—Sheet No. 313 N.W. .	2=1	1	
Kangra District—Sheet No. 285 N.W.	2=1	1	
North-Eastern Frontier Series.			
Sheet No. 23S.E.	1=4	1	
North-Western Trans-frontier Series.			
Sheet No. 28S.E.	1=4	1	With additions to railways up to 1893.
South Eastern Frontier Series.			
Sheet No. 2 N.W.	1=4	1	
Sheet No. 2	1=8	1	2nd edition.
South Western Asia.			
Sheets Nos. 66 N.W. and 66 S.W.	1=4	2	

Title.	Scale.	Number of Sheets.	Remarks.
Plans of Cities and Cantonments.	In. M.		
Kalka town, 1893	48=1	6	
Naini Tal	20=1	5	
Calcutta (1887 to 1894)	16=1	9	
Calcutta and Suburbs, 1895	3=1	4	
Calcutta and Suburbs, 1895	3=1	4	With additions and corrections to roads to March 1896.
Index Maps.			
To the standard sheets of Central India and Rajputana, sheets Nos. 1 and 2	...	2	
To the Forest Surveys in District Sambalpore	1=8	1	
To the Forest Surveys in District Bilaspur	1=12	1	
To the standard sheets of Bengal	...	1	With additions to 1895.
To the standard sheets of the Punjab	...	1	With additions to 1895.
Statistical Maps.			
Railway map of India	1=48	4	Railways brought up to October 1895.
India showing Railways	1=80	1	Corrected to 31s March 1896.
Administration Report Maps.			
Amiritsar, Angul, Backergunge, Bogra, Chittagong, Chittagong Hill Tracts, Damoh, Fatehpur, Hamirpur, Lucknow, Manbhum, Meerut, Moradabad, Muttra, Muzaffarnagar, Mymensingh, Pertabgarh, Purnea, Puri, Rajshahi, Shahjahanpur, Singhbhum, and Tipperah	1=8	23	
Almorah	1=10	1	
Garhwal	1=12	1	
Hoshangabad	1=12	1	
Mirzapur	1=12	1	
Bastar Feudatory States	1=16	1	
Bhagalpur	1=16	1	
Sunderbans	1=16	1	
Bengal	1=80	1	
Punjab (with hills)	1=80	1	
Miscellaneous.			
Nos. 8 and 92 Anandavadi and Milchingam reserved forests, Tiruvannamalai taluk, South Arcot District, Madras	4=1	1	
No. 7 Chinnasamudram reserved forests, Tiruvannamalai taluk, South Arcot District, Madras	4=1	1	
Javidi Hills reserved forests, Tiruvannamalai taluk, South Arcot District, Madras	4=1	4	
Javidi Hills reserved forests, Terupatur and Uttankarai taluks, Salem District, Madras	4=1	8	
Javidi Hills, Palur taluk, North Arcot District, Madras, Sheets Nos. 1 to 11	4=1	11	
No. 80, Kalladipatti reserved forests, Uttankarai taluk, Salem District, Madras	4=1	1	
Kalrayan Hills reserved forests, Salem and Uttankarai taluks, Salem District, Madras, Sheets Nos. 1, 2, 3, 5 and 6	4=1	5	
No. 110, Pattikonda reserved forests, Vellore taluk, North Arcot district, Madras	4=1	1	
Hoogly River, Sheets Nos. 1 and 2	2=1	2	
Portion of boundary between Nepal and the North-Western Provinces along the Sarda River, 1893	2=1	3	
Route Map for the Western Himalayas, Kashmir, Punjab and Northern India with portions of Afghanistan, Baluchistan, etc.	1=32	1	With additions to railways to 1895.
Conventional Signs to be used on Topographical Maps for reduction	...	1	With additions and corrections to August 1896.
Conventional signs to be used on Topographical Maps	...	1	With additions and corrections to August 1896.
Triangulation Charts.			
Gujarat Survey; Degree Sheet, No. VIII	1=2	2	
Gujarat Survey; Degree sheet No. IX	1=2	2	
Madras Forests, Tinnevelly District 1886-92	1=2	2	

APPENDIX.

EXTRACTS

FROM

REPORTS BY EXECUTIVE OFFICERS.

BALUCHISTAN AND UPPER BURMA.

Statement of the outturn of work executed by No. 24 Party during Season 1894-95.

Description of details.	Principal Triangulation.		
	Capt. Burn.	Lt. Fraser.	Totals and Means.
Number of stations newly fixed	6	2	8
" " figures completed	3	1	4
Length of series in miles completed	50	18	61
" " approximate series in miles in advance	23	104	127
Area of triangulation in square miles	1146	360	1506
Average triangular error in seconds	0·″33	0·″58	0·″46
Astronomical azimuth of verification	1	1	2
Average probable error of angles in seconds	0·″12	0·″22	0·″17
Number of principal stations selected in advance	2	5	7
" " station platforms constructed	11	...	11
" " stations the elements of which have been computed	6	2	8
Area embraced by the triangulation to points exterior to main triangulation in square miles	310	175	485
Number of secondary points fixed	6	5	11
" " stations and points the heights of which have been determined	11	7	18
Number of miles of rays and paths cleared	10	...	10
" " preliminary charts of triangulation	1	1	2
Mean co-efficient of refraction	·062	·069	·065

Extract from the Narrative Report of MR. G. P. TATE, *Extra Assistant Superintendent, 6th grade, on the Survey Operations with the* BALUCH-AFGHAN BOUNDARY COMMISSION, *Season 1895-96.*

The scope of this Commission included the delimitation of the frontier between British territory and Afghanistan, from the southern limit of Waziristan up to the eastern confines of the Persian Empire. Of the large extent of country lying between these widely separated limits, the boundary had been settled only as far south as the British frontier outpost of Chaman, when the operations were brought to a close in June 1895. The past winter was devoted to the demarcation of the boundary between this point and the Persian frontier, where the hill known as the Koh-i-Malik Siah had years ago been recognised as the tri-junction point common to the boundaries of Persia, Afghanistan and the Khanate of Kalat or Baluchistan. The Koh-i Malik Siah had in consequence obtained a widespread celebrity. But although it had been much written about, it had previously never been properly identified, nor had its position been laid down with any amount of exactitude, though a very rough approximation of its true position had been obtained by means of native agency.

* * * * *

The formal meeting of the two Commissioners, Sardar Muhammad Umar Khan, Chief of the Nurzais, on the part of Afghanistan, and Captain McMahon on the part of the Government of India, took place on the 3rd February 1896 at the Wachdara, after which the work of delimitation was commenced.

* * * * *

The task of determining the actual site on which each pillar was to be built fell to the Political Staff, but the Survey Officer's services were not infrequently requisitioned in the matter. In the early stage of the delimitation, as no fresh triangulation was necessary, the majority of the boundary pillars were laid down on the map by the Survey Officer in person. A proportion of these were afterwards fixed by triangulation.

* * * * *

For the first sixty miles of its course the boundary followed the crest of the western scarp of the Peshin plateau in a general southerly direction, and includes the small village, and the lands around it, of Iltaz Karez in Afghan territory. This village and its lands are the property of the Barechi Sardar, Samand Khan, the greater part of whose possessions and tribe are situated in the plains of Shorawak, within Afghan territory; and by including the lands around Iltaz Karez in Afghanistan, the whole of the possessions of this Chief and of his tribe now lie within Afghan territory. The boundary line leaves the crest of the hills and strikes westwards from the highest point of the plateau known as Thobi, where boundary pillar No. 144 is the same point as Alagh H. S. of the Nushki Shorarud triangulation of 1885-86. From this point the boundary crosses a tract of country which is fairly well known and several gaps that remained in the existing map were filled up on the outward and on the return journeys of the Commission.

The Chagai fort, which had been seized by the Afghans about ten or twelve years ago, lies within this sheet. It had been for several generations the head-quarters of the Chief of the Eastern section of the Sanjaranis, who was expelled from the fort and compelled to seek refuge within British territory, or rather that of Kalat. As the fort of Chagai was left to the south of the boundary line it was included within Baluchistan limits, and the formal surrender of the fort itself was made on the return journey, while the Mission was encamped in its vicinity.

The country traversed so far was covered by the Khárán triangulation by Mr. Tate, of 1886-87, and by that carried out in 1884-85 by the Afghan Boundary Commission. No fresh triangulation was therefore needed. A check line was run in the vicinity of Chagai over a distance of above 30 miles, which proved the work, in that part at least, to be worthy of acceptance till such time as a more elaborate survey of the country is necessary.

The fresh work executed with the Commission began after the 64° meridian of longitude was crossed, both as regards triangulation and topography. This extension of the former westwards is based on the work of the Afghan Boundary Commission in 1884-85 and emanates from the sides Aniak H. S. to Arbu H. S., Arbu H. S. to Samuli H. S. and the latter to Malik Teznàn. An intersected point (Salia 1) of the existing triangulation was selected as a station of the new triangulation, and observations were taken from it to all the old stations that were visible and these fresh angles were used with those already taken in 1884-85 to obtain the first station of the extension of the triangulation to the west.

It should be remarked before proceeding further that it was not possible to set up cairns in advance, nor to use luminous signals, and bare hill-tops were in consequence observed to. Only after the observations at a hill were concluded was it possible to erect a small cairn over the spot where the theodolite had been set up. Moreover, the choice of stations was restricted to such hills as lay within easy reach of the line of advance, so as to allow of the observations being taken in the course of the day's march. For, besides objections to delays on political grounds, the season was too far advanced to make any delays advisable except in cases of great urgency.

* * * * *



Photo-etching.

Survey of India Offices, Calcutta, March 1897.

EVENING AT KANI, THE COMBINED CAMP, BRITISH & AFGHAN.

Enlarged from a negative by Mr. G. P. Tate.

The country between the 64° meridian and that of 62° 30′ consists for the greater part of lofty hills that rise to a considerable elevation above sea-level. They rise sheer out of the country at their foot, and are composed for the most part of granite and igneous rocks. The clay slates and shales of the Khwájá Amrán are not found in this section. The highest points of these hills, with two exceptions, are inaccessible. Attempts were made to ascend the highest point of the Malik Náro mass, but they proved abortive and the attempt was abandoned. The Malik Dokand hill is the most impressive of any of this region. It stands, a solitary, inaccessible mass of rock, rising sheer out of the plain at its base, and its two peaks make a landmark that on a clear day is visible for many miles around. It is altogether inaccessible. At its foot, to the north-west, is a quarry out of which a species of alabaster in blocks is obtained. And in all the hills around alabaster of a similar quality can be obtained more or less plentifully. This alabaster is much prized in Afghanistan for the ornamentation of the interiors of dwellings. At the foot of these grand masses of hills the country is covered with a sea of sand-hills. These are composed chiefly of a fine, salmon-coloured drifting sand, and are destitute of vegetation, except where a species of tamarisk, called by the natives *tá-gaz*, grows in the hollows between the sand-hills. The nations discriminate between the drift sand and those sand-hills which are fairly stable ; the former they call *búd*, and the latter *reg* or *rek*. The hills around the Malik Náro were at one time undoubtedly connected with the mass further to the west called the Koh-i-Sultan, which also falls within this section of the boundary, by low, isolated ridges of rock. The greater part of these are now almost hidden away under the sand which lies banked up on their slopes. Between the hills about Malik Náro and the Koh-i-Sultan is a small hollow tract of country where water from wells is obtainable within a few feet of the surface, and where the water is sweet. The great natural spring of Manzil is situated in this tract, and the natives have a vague tradition that this was once a Hamun which had become filled up by drift sand. It may possibly have been a portion of the great hollow of Zirreh or Zarang, by which name the country was known to the Arabs, and which had existed before their time, as the name "Drangianœ" is applied by Arrian to the same country.

The Koh-i-Sultan is a group of hills some of whose peaks rise to a considerable altitude. These hills abound in minerals ; sulphur is very abundant ; and the plant from which assafœtida is obtained grows very plentifully on the otherwise bare and arid slopes of the hills. The assafœtida is sought after not only by the inhabitants of the surrounding country, but by the Afghans of Zhob and far-distant Ghazni. The latter form large caravans and visit the Koh-i-Sultan every year, usually staying some months to collect the assafœtida.

Three of the highest points in the Koh-i-Sultan have been fixed by triangulation : the highest is 7,656 feet above sea-level ; the next is a prominent and inaccessible peak on the eastern edge of the group, 7,558 feet high ; and the third is the Koh-i-Kansuri, situated at the western limit, and 6,389 feet in height. Of these, the first is suitable for a station of observation, but as it lies in the heart of the mass it was not accessible from the line of advance.

* * * * *

The details shown in the existing maps, between the meridians of 64° and 62° 30′, were found to be unreliable, and a survey was made of the ground traversed by the Mission. For this purpose half the staff of surveyors was left behind with the main camp when the last section was entered upon. The re-survey was carefully made, the surveyors engaged on this task marking the positions of their plane-table interpolations upon their field sections. Advantage was taken of the presence of the Afghan Commissioner to carry on the detail surveys across the boundary line into Afghan territory up to the southern edge of the waterless desert south of the Helmand river. It was not practicable to do much beyond its limit, and indeed, with the exception of one or two of the larger mountain streams, the channels of which could be traced for a short distance into the desert before becoming obliterated, there was no detail beyond very unimportant sand-hills that was worth the trouble of surveying.

That part of the detail lying to the south of the Koh-i-Malik Náro and Teznán was surveyed during the closing days of the Mission, while the main body was on the way back to Quetta. This was in the middle of May, and the surveys were carried out at considerable risk to health, and also to life, by the plane-tablers engaged on them, as at that time the temperature in the shade stood at 119° Fahr., while the solar radiation thermometer registered 205° in the sun. These were temperatures hardly bearable at rest, and it was a matter for congratulation that the surveyors were able to finish their work without a mishap, as the high temperatures to which they were exposed in the discharge of their duties were aggravated by the physical exertions rendered necessary by the nature of their duties.

* * * * *

The last portion of the boundary lay between the meridians of 62° 30′ and 61°. Here little work of a reliable nature had previously been done. The survey of this portion was, therefore, the most important part of the work of the survey detachment. Unfortunately this was also the most inhospitable tract crossed by the Mission, and was traversed with the utmost speed possible.

* * * * *

A very conspicuous hill known as the Koh-i-Dalil had been fixed in this part of the country from the stations of the Jalk trigulation of 1889-90 by Mr. Tate, the sides determining its position being close upon 100 miles in length. This point and its co-ordinates were used as the origin of the triangulation in the third and last section of the boundary work. The Koh-i-Dalil, though not of great height, happened to be a singularly conspicuous object, and owing to this fortunate circumstance it was connected not only with the triangulation dependent on the Sáindak base by observations, but it was also observed to from the Koh-i-Malik Siah, whence it was visible.

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The heights that were obtained for the triangulation west of the meridian of 62° 30′ were the result of readings of several boiling-point thermometers. Distilled water was always used for this purpose, and a spirit lamp instead of an ordinary fire. And whenever possible the readings for the boiling point were obtained from several thermometers and their means recorded, the temperature of the air being at the same time carefully recorded.

The line of advance of the Boundary Commission lay in a direction parallel to the strike of the hills, and as the route kept to the *talus* at the foot of their northern slopes, it was not possible to visit any of the higher peaks on the watershed, as these were situated at a distance from the route. The lower hills were in consequence only accessible for purposes of triangulation, but the watershed has been laid down by observations to the more conspicuous peaks that are situated upon it. From the triangulation observations were obtained to the southern and apparently the higher of the two peaks of the Koh-i-Taftan, the loftiest point in the mountains of Eastern Persia. It rises to an elevation of over 12,000 feet, as determined by triangulation; and quite at the end of April there was still a great quantity of snow apparently on both its summits.

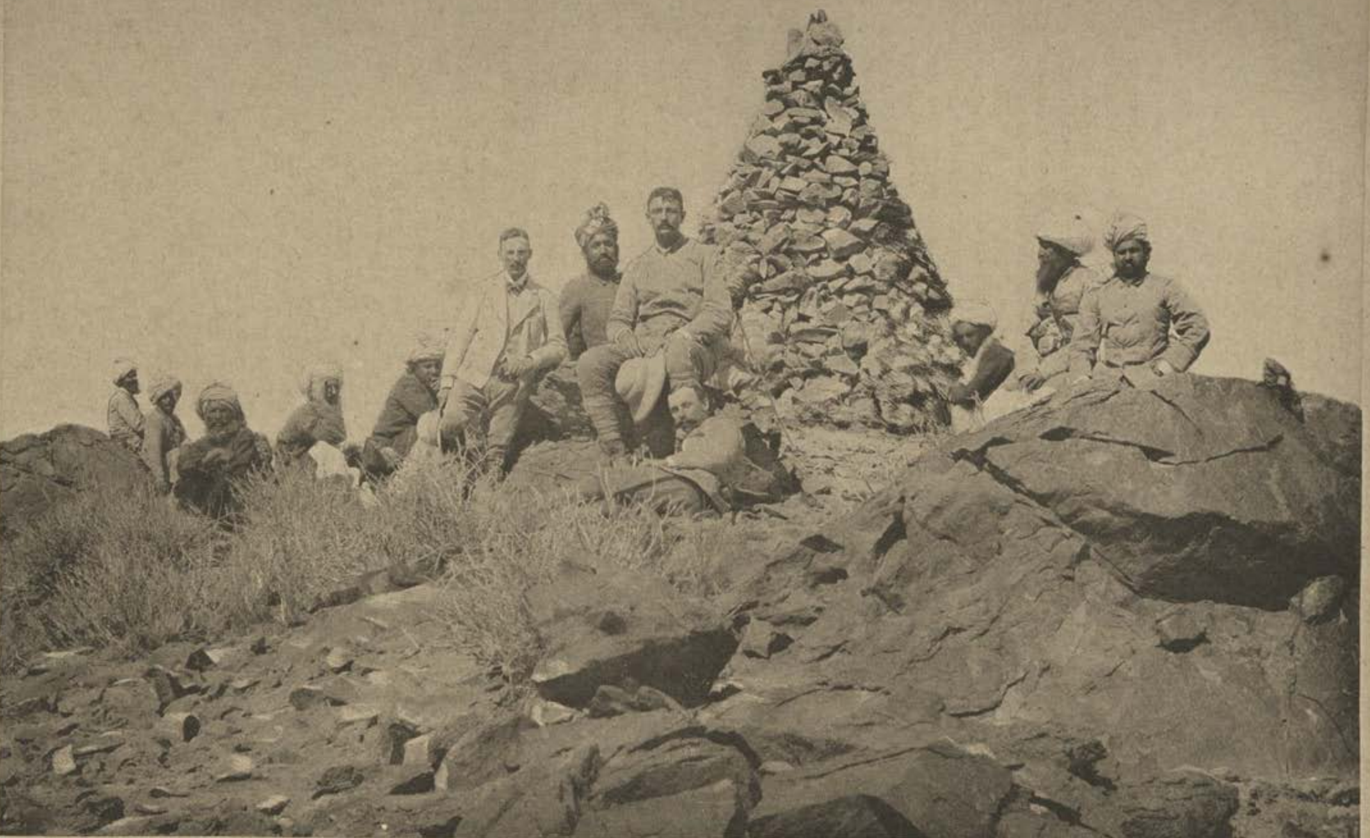
From the summit of the Koh-i-Malik Siah angles were taken to all prominent peaks that were visible. In this way, and from another station on a low hill east of Malik Siah, points have been fixed to the north in the hills that lie on the eastern edge of Seistan. These points have been called Palangáns 1, 2 and 3. Of these it is doubtful whether the first two have been correctly identified at both stations from which they have been laid down; but there is no doubt in the case of Palangán 3. This is a prominent peak, with a sheer scarped fall towards the east, with low hills at its foot, and between it and the Seistan plain. These points are not the same peaks that were laid down by graphical triangulation by the Afghan Boundary Commission in 1884-85. On the last occasion the ranges were seen end on and in perspective, and those points which appeared to be most prominent were observed to. In 1884-85 the Palangán range lay parallel to the line of advance of the Boundary Commission. The peaks were consequently seen against the sky and fixed with more certainty than if they had been viewed in perspective. A long low ridge was seen very far in the distance to the north-east from the summit of the Koh-i-Malik Siah, and readings were taken to its western and eastern extremities. The Afghan Governor of Chaharburjak in the Helmand, with other *maliks* from the country under his jurisdiction, was present with the Afghan representative on the summit of the Koh-i-Malik Siah; and from the former, whose statement was confirmed by other *maliks* present, it was learnt that the ridge in question was the Koh-i-Khwaja, and the readings to its two extremities have been distinguished by this name in the record of observations at the Koh-i-Malik Siah. After the angles had all been observed, a mark stone, bearing the number 186 in roman numerals, was placed on the site of the station and fixed as usual by masonry, and a cairn ten feet in height was raised over it which was whitewashed before leaving the hill. The illustration shows the pillar as it stood. The three European officers whose portraits appear are Captain McMahon, the British Commissioner, Surgeon-Captain Maynard, Medical Officer and Naturalist to the Mission, and Mr. Tate, Survey Officer.

A special survey was made, on the scale of 1 inch = 2 miles, of the hills known as the Rabat Koh and the Koh-i-Malik Siah, before leaving the ground.

The work of the Commission, so far as the actual demarcation was concerned, had now come to an end. There still remained the joint agreement to be drawn up by the Political staff and approved by the Joint Commissioners, and the maps to prepare which were to illustrate the various clauses of that agreement; and for this purpose it became necessary to rejoin the main camp which had been left behind at Rabat under the Malik Dokand hill.

* * * * *

The Mission broke up at the Koh-i-Malik Siah and marched with all speed to their main camp, the Afghans marching back by way of the Helmand river, and the British Commissioner and party by the same road as they had come. The latter reached their main camp on the 29th April and the Afghan Commissioner a day or two later.



Photoetching

Survey of India Offices, Calcutta, March 1897.

SUMMIT OF KOH-I-MALIK SIAH.

Enlarged from a negative by Mr. G. P. Tate.

DRAWING OFFICE, CALCUTTA.

Section I.—Geographical Drawing and Compilation.

Statement showing the work performed during the year 1895-96.

Title.	Scale.	Number of Sheets.	Remarks.
	In. M.		
ATLAS OF INDIA.			
Sheets Nos. 1 S. E., 1A S. E., 2 N. E., 2 S. E., 3 N. E., 3 S. E., 5 N. E., 8 S. E., 8 S. W., 10 N. E., 10 S. W., 14, 21 S. E., 22 N. E., 22 S. E., 22 S. W., 23 N. W., 27 S. E., 29, 30, 33 S. W., 34 S. W., 37 N. E., 39 S. E., 40, 44, 51 N. E., 51 S. W., 52 N. E., 52 S. E., 53 N. E., 53 N. W., 53 S. W., 56, 57, 58, 62, 66 N. E., 66 S. E., 69 S. W., 70 S. E., 70 S. W., 72, 74, 80, 87 S. E., 104, 113, 114, 115, 121, 124 S. E., 124 N. W., 124 S. W., 125 N. E., 125 S. E., 126 N. E., 126 N. W., 126 S. W., 127 N. E., 127 S. E., 129 S. E., 130 N. E., 130 N. W., 130 S. W. and 211	1=4	66	Additions made to railways, roads, canals, and changes to boundaries.
Sheets Nos. 3 S. E., 5 S. E., 7, 9 S. W., 14, 14 S. E., 24 S. E., 26 S. E., 27 N. E., 27 S. E., 27A N. E., 29, 31 N. E. 31 S. E., 31 N. W., 31 S. W., 34 N. W., 35 N. E., 40 S. E., 40 S. W., 41 N. E., 41 S. E., 41 N. W., 41 S. W., 42, 42 N. E., 44A. S. W, 48 N. E., 48 S. W., 49 N. W., 50 S. E. 52 N. E., 52 S. E, 53 N. E., 56, 57, 58 N. E., 58 S. E., 58, 58 N. W., 58 S. W., 59 N. E., 59 N. W., 61 S. E, 65, 67, 67 N. E., 68, 68 S. W., 69 N. E., 69 N. W., 73, 76 N. W., 79, 79 S. W., 80, 80 N. E., 80 N. W., 87 N. E., 87 S. E., 87 N. W., 87 S. W., 102, 103, 104, 105 N. E., 107, 108, 112, 113, 115, 116, 126 S. E., 127 N. W., and 130 . . .	1=4	75	Additions made to names and detail for engraving.
Sheets Nos. 24 N. E., 26 S. E., 27A N. E., 37 N. W., and 48 N. E.	1=4	5	Hills, brush-shaded, for engraving.
GENERAL MAPS.			
India (3rd edition) (Litho.) .	1=32	6	Railways to date.
Do. (showing railways) (Photo.)	1=32	6	Additions to date.
Do. (do.) (Litho.)	1=32	6	Do. do.
Do.	1=32	6	Do. to railways to date.
Do. (showing canals) (Photo.)	1=32	6	Do. do. do.
Do. (showing railways) (do.)	1=48	4	Railways to date.
Do. (engraved) . . .	1=64	4	Additions to date.
Do. (do.) . . .	1=96	1	Do. do.
Do. (do.) . . .	1=128	1	Brush-shaded hills for engraving.
PROVINCIAL MAPS.			
Assam (Litho.)	1=16	1	Additions and corrections to date.
Bengal, Bihar, Orissa, and Chota Nagpur (Litho.) . . .	1=16	2	Additions to railways to date.

DRAWING OFFICE, CALCUTTA.

SECTION I—*continued.*

Statement of work—continued.

Title.	Scale.	Number of Sheets.	Remarks.
	In. M.		
PROVINCIAL MAPS—*contd.*			
Bengal, Bihar, Orissa, and Chota Nagpur (engraved) . .	1=16	2	Brush-shaded hills for engraving.
Berar (engraved) . . .	1=8	1	Additions to date.
Bombay presidency (do.) .	1=16	1	Do. do.
Ditto . . .	1=32	1	Do. and corrections to date.
Central India Agency (engraved)	1=16	2	Do. to railways to date.
Gujarat (do.) .	1=16	1	Brush-shaded hills for engraving.
Madras—(Ceylon portion) (do.) .	1=16	1	Corrections to date.
Mysore (do) .	1=16	1	Additions to date.
North-Western Provinces and Oudh	1=16	1	Additions to date.
Punjab (engraved) . . .	1=16	4	Brush-shaded hills.
Punjab and Kashmir . .	1=16	4	Additions to railways.
Do. (skeleton) . . .	1=32	1	Corrections to date.
Rajputana Agency (engraved) .	1=16	2	Additions to date.
Upper Burma (2nd edition) .	1=16	2	Corrections to date.
DIVISIONAL MAPS.			
Bengal, Behar, Orissa, and Chota Nagpur . . .	1=64	2	Additions to railways to date.
Patna	1=8	2	Additions to date.
DISTRICT MAPS.			
Champaran, Faridpur, Howrah, Jessore, Noakhali, Puri . .	1=4	6	Completed and published.
Backergunge, Bankura, Bogra, Burdwan, Cachar, Cuttack, Darjeeling, Goalpara, Hazara, Hazaribagh, Jalpaiguri, Kamrup, Karnal, Khulna, Manbhum, Nadia, Naga Hills, Nowgong, 24-Parganas, Peshawar, Purnea, Raipur, Sambalpur, Saran, Shahabad, Sibsagar, Sylhet, Tipperah .	1=4	28	Additions and corrections made to date.
STANDARD MAPS.			
BENGAL—			
Sheet No. 156	1=1	1	Completed and published.
BOMBAY—			
Sheet No. 245	1=1	1	Additions and corrections completed and published.

DRAWING OFFICE, CALCUTTA.

SECTION I—*continued.*

Statement of work—continued.

Title.	Scale.	Number of Sheets.	Remarks.
	In. M.		
STANDARD MAPS—*contd.*			
CENTRAL INDIA AND RAJPUTANA—			
Sheets Nos. 96, 97, 419 and 483	1=1	4	Completed and published.
Sheets Nos. 71, 83, 106, 110, 119, 140, 147, 175, 177, 192, 194, 200, 201, 205, 208, 209, 223, 226, 229, 230, 241, 255, 257, 259, 261, 262, 264, 267, 274, 284, 303, 312, 318, 320, 321, 331, 332, 335, 343, 344, 345, 364, 379, 420, 427, 441, 448, 449, 454, 466, and 472	1=1	51	In progress.
CENTRAL PROVINCES—			
Sheets Nos. 51, and 206, 207, 224, and 225 (in one sheet) .	1=1 & 2	2	Completed and published.
Sheets Nos. 6, 12, 17, 35 and 50	1=1	5	In progress.
SOUTH WEST ASIA—			
Sheets Nos. 66 N. W. and 66 S. W.	1=4	2	Completed and published.
UPPER BURMA AND SHAN STATES—			
Sheets Nos. 312 and 313 .	1=1	2	Completed and published.
Sheets Nos. 314 and 358 .	1=1	2	In progress.
UPPER BURMA (NORTH-EAST FRONTIER SERIES)—			
Sheet No. 15 N. W. . . .	1=4	1	Completed and published.
Sheets No. 15 (4th edition) and 23 (2nd edition) . .	1=8	2	In progress.
UPPER BURMA (SOUTH-EAST FRONTIER SERIES)—			
Sheet No. 2 N. W. . . .	1=4	2	Completed and published.
Sheets Nos. 3 N. E. (4th edition), 3 S. E. and 3' N. E. .	1=4	3	In progress.
Sheets Nos. 6 N. E. and 6 N.W. (7th edition) . .	1=4	2	Ditto.
Sheets Nos. 2 (2nd edition) and 13	1=8	2	Completed and published.
Sheet No. 1 (5th edition) .	1=8	1	In progress.
Sheet No. 4 (2nd edition) .	1=8	1	Ditto.
Sheet No. 5	1=8	1	Ditto.
Sheet No. 6 (2nd edition) .	1=8	1	Ditto.
Sheet No. 9	1=8	1	Ditto.
Sheet No. 10	1=8	1	Ditto.

DRAWING OFFICE, CALCUTTA.

SECTION I—*continued.*

Statement of work—continued.

Title.	Scale.	Number of Sheets.	Remarks.
	In. M.		
ADMINISTRATION REPORT MAPS.			
Bengal	1=80	1	Additions and corrections to date.
Berar	1=74	1	Hills brush-shaded.
Punjab	1=80	1	Additions to railways to date.
BENGAL—			
Backergunge, Bogra, Champaran, Chittagong, Cuttack, Fatehpur, Mymensingh, Noakhali, Purneah, Puri, Rajshahi, Rungpur, Sundarbans, Tipperah	1=8	14	Additions and corrections to date.
Sonthal Parganas	1=10	1	
Mirzapur, Singbhum . .	1=12	2	
Bhagalpur	1=16	1	
CENTRAL PROVINCES—			
Balaghat	1=8	1	Outline and names completed.
Bhandara	1=8	1	Additions and corrections to date.
Bilaspur	1=16	1	Ditto ditto.
Garjhat States	1=8	1	Hills brush-shaded.
Sambalpur	1=16	1	Additions and corrections to date.
NORTH-WESTERN PROVINCES—			
Cawnpore	1=8	1	
Hamirpur	1=8	1	
Naini Tal	1=10	1	
PUNJAB—			
Dera Ismail Khan . . .	1=16	1	
Gujranwala	1=8	1	
Jhang	1=8	1	
Rawalpindi	1=8	1	Hills brush-shaded.
INDEX MAPS.			
Upper Burma and Shan States .	1=16	1	Additions and corrections to date.
Punjab	1=50	1	
North-West Provinces . .	1=50	1	
Central Provinces . . .	1=48	1	
Assam	1=48	1	
SPECIAL MAPS.			
Districts Raipur and Chanda,	1=16	2	Additions and corrections to date.
His Excellency the Viceroy's Tour Map, 1896	1=64	1	Prepared.
His Excellency the Viceroy's Tour Map, 1896	1=80	1	Ditto.

DRAWING OFFICE, CALCUTTA.

SECTION I—*concluded.*

Statement of work—concluded.

Title.	Scale.	Number of Sheets.	Remarks.
MISCELLANEOUS.			
Map showing the Periar Main Channels and Branches	1=1	1	A trace made on vellum cloth for office copy.
Index to the standard sheets of Upper and Lower Burma	1=32	2	Brought up to date for Officer in charge No. 20 Party.
Conventional signs for Topographical Maps	...	1	Additions and corrections.
PLANS OF CITIES AND CANTONMENTS.			
Assam-Bengal Railway	4=1	1	A trace made on vellum cloth.
Calcutta	16=1	9	Outline and names for reduction to 6 inches = 1 mile.
Wellington Cantonment	12=1	1	A trace made on vellum cloth.
WORK DONE FOR OTHER DEPARTMENTS.			
MISCELLANEOUS.			
Canal Map of India	1=32	6	Corrections for Public Works Department.
Dang States	1=4	1	Prepared for the Conservator of Forests, Bombay.
Murree Hills	1=1	1	" " Adjutant-General, Rawalpindi.
Rangoon (10 miles radius)	1=1	1	" " " Rangoon.
Rawal Pindi (10 miles radius)	2=1	2	" " " Rawalpindi.
MAPS, COLOURED, ETC.			
Maps on various scales	...	11,21	For Surveyor-General's Office.
Ditto ditto	...	393	For other Departments.

Description of Work.	Number of Sheets.
Maps examined.	
Atlas sheets	94
General maps	13
Provincial maps	23
District maps	3
Standard maps	89
Plans of Cities and Cantonments	9
Administration Report maps	43
Index maps	21
Statistical and Extra-Departmental maps	416
Miscellaneous maps	6
Office copies of various maps, with additions and corrections in territorial boundaries and Public Works	272
Tracing prints prepared for Atlas reductions	25
Tracing of roads, canals and railways from originals supplied by P. W. D.	13
Engraved proofs of Atlas sheets in various stages	138
Engraved proofs of General and Provincial maps, including index charts	39
Engraved proofs of large-scale plans	16
Engraved proofs of Administration Report maps	69
Litho. proofs of General and Provincial maps, including index charts	29
Litho. proofs of District maps transferred from copper-plates	38
Litho. proofs of Statistical and Extra-Departmental maps	14
Photo. proofs of standard and various other maps	356
Colouring of maps for various purposes	399
Projection and examination of graticules and plotting of points	37
TOTAL	2,162

N.B.—In addition to the above, many miscellaneous jobs, such as supply of geographical data to various officials, calculation of areas, computation of graticules for the projection of the sheets of the Indian Atlas, examination of the proof sheets of the "Survey of India Notes" as to the correct orthography of geographical names, and various other minor works have been performed by the Examining Section.

DRAWING OFFICE, CALCUTTA.

SECTION II.—REVENUE DRAWING AND COMPILATION.

Statement showing the work performed during the year 1895-96.

Title.	Scale.	Number of Sheets.	Remarks.
STANDARD MAPS.	In. M.		
PUNJAB.			
Indus Riverain Survey.			
Sheets Nos. 23, 24, 25, 26, 27, 41, 42, 43, 45, 46, 47, 48, and 68	1=1	13	Proofs passed; press order given.
Sheets Nos. 18, 33, 34, 35, 36, 49, 50, 51, 52 and 53	1=1	10	Fair maps examined with plane-table sections; corrected, and sent to press for reproduction.
(*Skeleton Maps of Indus River showing old course.*)			
Sheets Nos. 33, 34, 35, 36, 49, 50, 51, 52 and 53	1=1	9	Ditto ditto.
NORTH-WESTERN PROVINCES AND OUDH.			
Districts Naini Tal and Garhwal.			
Sheet No. 63	1=1	1	Fair maps corrected for re-photography. Proof returned to press for correction.
Districts Meerut and Moradabad.			
Sheet No. 31 (in 4 sections)	2=1	4	Fair map corrected for reprint.
Districts Meerut and Muzaffar-nagar.			
Sheet No. 17	1=1	1	Fair map corrected to May 1896. Proof sent to press for correction.
Sheets Nos. 17 and 18 (in 4 sections each)	2=1	8	Fair map corrected to July 1896. Proofs sent to press for correction.
Districts Meerut and Buland-shahr.			
Sheet No. 19	1=1	1	Additions and corrections made to roads and boundaries.
BENGAL.			
District Darjeeling (including British portion).			
Sheet No. 270	1=1	1	Proofs passed; press order given.
Sheet No. 269	1=1	1	Proofs sent to press for correction.
Sheets Nos. 269 and 270 (in 4 sections each)	2=1	8	Drawn for reduction to scale 1-inch=1 mile (second edition).
Districts Darjeeling and Jalpaiguri.			
Sheet No. 293	1=1	1	Proofs passed; press order given.
District Jalpaiguri.			
(Re-surveyed portion.)			
Sheets Nos. 293, 294, 295, 315, 316, 317, 337, 338, and 339	1=1	9	Proofs passed; press order given.
Sheet No. 294 (old and new incorporated)	1=1	1	Fair maps corrected and sent to press.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

Title.	Scale.	Number of Sheets.	Remarks.
STANDARD MAPS—*contd.*	In. M.		
BENGAL—*contd.*			
District Mymensingh.			
Sheets Nos. 349, 377, and 390 .	1=1	3	Proofs passed; press order given.
Sheets Nos. 347, 348, 389, and 390	1=1	4	Proofs examined and corrected.
BOMBAY.			
Sheets Nos. 176, 208, 209, 210, 308, 309, 310, 311, 334, 335, and 336	1=1	11	Proof passed; press order given.
Sheets Nos. 243 and 337 . .	1=1	2	Proofs returned to press for correction.
Sheets Nos. 301, 302, 327 and 329 (in 4 sections each) . .	2=1	16	Fair maps examined with field sections; corrected and sent to press for reduction by photography to scale 1 inch=1 mile.
Sheets Nos. 161, 164, 166, 183, 192 and 201 (in 4 sections each)	2=1	24	Fair maps corrected and sent to press for reduction by photography to scale 1 inch=1 mile for replenishing stock.
Sheet No. 79 N. W./4 . .	4=1	1	Fair map corrected. Proofs passed; press order given.
LOWER BURMA.			
Sheets Nos. 179, 181, and 182 .	1=1	1	Drawing completed and sent to press for publication on 2nd edition. Proofs examined and returned to press for correction.
Sheet No. 184	1=1	1	Proof returned to press for correction.
Sheets Nos. 281, and 282 (in 4 sections each) . . .	2=1	8	Fair maps corrected and sent to press for reduction by photography to scale 1 inch=1 mile for replenishing stock.
Districts Amherst and Thaton.			
Sheet No. 419	1=1	1	Proofs passed; press order given.
Sheets Nos. 426, 427 and 428 .	1=1	3	Proofs examined and returned to press for correction.
Sheets Nos. 423, 424, 475, and 478 (in 4 sections each) .	2=1	16	Fair maps examined and sent to press for reduction by photography to scale 1 inch=1 mile. Proofs corrected and passed; press order given
Sheets Nos. 420, 425 and 479 (in 4 sections each) . . .	2=1	12	Fair maps corrected and sent to press for reduction by photography to scale 1 inch=1 mile. Proofs returned to press for correction.
UPPER BURMA.			
Districts Mandalay and Sagaing.			
Sheets Nos. 166, 167, 168, 213, 214, 215, 216, 259, 260, 261 and 262	1=1	11	Proofs passed; press order.
District Minbu.			
Sheets Nos. 89, 90, 126, 127, 128, 129, 130, 174 and 175 . .	2=1	25	Fair maps examined and corrected.
PARGANA MAPS.			
PUNJAB.			
District Peshawar.			
Sheets Nos. 3, 5, 6 and 9 .	1=1	4	Corrected from 4-inch tracings received from the district officials.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
	In. M.		
PARGANA MAPS—*contd.*			
BENGAL.			
District Shahabad.			
Sheets Nos. 1 to 16 . . .	1=1	15	Printed maps corrected for reprint. Proofs examined and press order given.
District Gaya.			
Sheets Nos. 14 and 15 . .	1=1	2	Additions and corrections made to roads and boundaries.
Sheets Nos. 1 to 7, 9 to 13, 16, 17, 19, 20 and 24 . . .	1=1	17	Printed maps touched up, corrected and sent to press for reproduction. Proofs passed; press order given.
Sheets Nos. 8, 14, 15, 18, 21, 22, and 23	1=1	7	Printed maps touched up, corrected and sent to press for reproduction.
District Monghyr.			
Sheet No. 14	1=1	1	Additions and corrections made to roads and boundaries.
District Manbhum.			
Main Circuit No. 2 . .	1=1	1	Printed map touched up, corrected and sent to press for reproduction.
District 24-Parganas.			
Sheet No. 1	1=1	1	Additions and corrections made to roads and boundaries.
District Backergunge.			
Main Circuits Nos. 7 and 8 .	1=1	1	Printed map touched up, corrected and sent to press for reproduction.
District 24-Parganas.			
Dhi Panchanogram.			
Grand division, 1 Subdivision 17	99 ft.=1	1	Ditto ditto.
Grand division, 4 Subdivision [illegible]	99 ft.=1	1	Ditto ditto.
Grand division, 6 Subdivision 2 .	99 ft.=1	1	Ditto ditto.
ORISSA DIVISION.			
District Cuttack.			
Sheets Nos. 2 and 3 . .	1=1	2	Additions and corrections made to roads and boundaries.
District Balasore.			
Sheets Nos. 3, 6 and 9 . .	1=1	3	Ditto ditto.
CENTRAL PROVINCES.			
District Bhandara.			
Sheets Nos. 1 to 17 . . .	1=1	17	Additions and corrections made to boundaries and interior details from the 16-inch scale tracings received from the Settlement Officer.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
PARGANA MAPS—*contd.*	In. M.		
CENTRAL PROVINCES—*contd.*			
District Betul.			
Sheets Nos. 1 to 9 . . .	1=1	9	Additions and corrections made to boundaries and interior details from the 16-inch scale tracings received from the Settlement Officer.
District Bilaspur.			
Sheets Nos. 1 to 9 . . .	1=1	9	Additions and corrections made to boundaries and roads from the information received from the Settlement Officer.
District Chindwara.			
Sheets Nos. 1 to 12 . . .	1=1	12	Additions and corrections made to boundaries and interior details from the 16-inch scale tracings received from the Settlement Officer.
District Hoshangabad.			
Sheets Nos. 1 to 13 . . .	1=1	13	Additions and corrections made to roads, boundaries, etc., from the information received from the Settlement Officer. Proofs passed; press order given.
District Raipur.			
Sheets Nos. 1 to 17 . . .	1=1	17	Additions and corrections made to boundaries and interior details from the 16-inch scale tracings received from the Settlement Officer.
District Seoni.			
Sheets Nos. 1 to 10 . . .	1=1	10	Ditto ditto.
DISTRICT MAPS.			
PUNJAB.			
Gujranwala (in 4 sections) .	1=2	4	Additions and corrections made to roads and boundaries.
Gujrat (in 2 sections) . .	1=2	...	Ditto ditto.
North-Western Provinces and Oudh.			
Mirzapur	1=2	6	} Proofs passed ; press order given.
Naini Tal	1=2	2	} Proofs passed ; press order given.
Garhwal	1=2	6	Proofs examined and returned to press for correction.
BENGAL.			
Gaya (in 3 copies) . . .	1=4	3	Additions and corrections made to roads and boundaries.
Cuttack and Bilaspur . .	1=4	1	Ditto ditto.
Darjeeling	1=4	1	Ditto ditto.
CENTRAL PROVINCE.			
Nagpur and Warda . .	1=2	4	Proofs examined and returned to press for correction.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
PLANS OF CITIES AND CANTONMENTS.	In. M.		
Belgaum	8=1	2	Proofs passed ; press order.
Dharwar	8=1	2	Fair maps corrected and sent to press for reproduction.
Naini Tal	20=1	5	Fair maps corrected and sent to press for reproduction. Proofs passed ; press order given.
Moulmein Town in (67 sheets) .	1=50ft.	40	Fair maps corrected and sent to press for reproduction.
Lucknow (showing the British position and the Military operations in 1857-58) . . .	3=1	1	Proofs passed ; press order given.
Cawnpore (showing the British position and the Military operations in 1857-58) . . .	2=1	1	Drawn. Proofs passed ; press order given on 1-inch scale.
Bassiratganj (District Unao) (shewing the British position and the Military operations in 1857-58)	4=1	1	Drawn. Proofs passed ; press order given on 2-inch scale.
Bithur (District Unao) (showing the British and the Military operations in 1857-58) . .	4=1	1	Ditto ditto.
MISCELLANEOUS MAPS.			
Hooghly River, (in 2 sections) .	2=1	2	Proofs examined and returned to press for correction. Press order given.
Calcutta and Suburbs (in 4 sections)	3=1	4	Additions, corrections and alterations made and sent to press for reprint.
Boundary between district Sylhet and Khasi and Jaintia Hills (in 3 sheets)	1=1	3	Corrections made.
Triangulation Charts of Gujrat Survey.			
Half Degree Sheets Nos. 1, 7, 8 and 9 (in 2 sections each) .	1=2	...	Proofs passed ; press order given.
Index Maps.			
For Administration Report .	various.	7	Drawn and sent to press.
Ditto ditto .	"	19	Corrected to 1896 and sent to press.
Tracings prepared.			
Tracings of sheets . . .	"	36	
Village plans	"	41	
Maps coloured.			
Maps on various scales . .	"	204	For Surveyor-General's Office.

DRAWING OFFICE, CALCUTTA.

SECTION II—*concluded.*

Statement of work—concluded.

DESCRIPTION OF WORK.	REMARKS.
Computations examined.	
District Mandalay, Seasons 1889-91.	
,, Minbu ,, 1891-92.	
,, Mergui ,, 1889-93.	
,, Chittagong ,, 1889-90.	
,, Tipperah ,, 1889-90.	
,, Lakhimpur ,, 1891-92.	
Traverse data, etc., supplied.	
District Chhindwara along Pagara Jagir (30 pages) .	To O. C. No. 9 Party.
,, ,, ,, Pachmari Jagirs (15 pages) .	Ditto ditto.
,, Narsinghpur along district Chhindwara (16 pages)	Ditto ditto.
Forest blocks and village traverses district Chhindwara (25 pages)	Ditto ditto.
District Mandla, Sub-Circuit No. 7 (12 pages) . .	Ditto ditto.
,, Tarai along district Bareilly (4 pages) . .	To O. C. No. 8 Party.
Rampur State along district Bareilly (13 pages) .	Ditto ditto.
Raipur forest blocks (10 pages)	To Superintendent, Forest Surveys.
Gorakhpur forest blocks (10 pages)	Ditto ditto.
Seoni and Saugor forest blocks (10 pages) . .	Ditto ditto.
District Mandla along district Balaghat (26 pages) .	Ditto ditto.
,, Gorakhpur along Gandak River (6 pages) .	Ditto ditto.
,, Minbu western boundary (38 pages) . .	To O. C. No. 3 Party.
Traverses of certain villages of district Mandalay (20 pages)	Ditto ditto.
District Hoshiarpur along Beas River . . .	To O. C. No. 18 Party.
Jhansi villages (40 pages)	To Superintendent, Land Record Surveys, North-Western Provinces and Oudh.
Village traverses (82 pages)	To Public Officers.
Field area statements district Cuttack (60 pages) .	To Settlement Officer.
,, ,, ,, ,, Kyaukse (52 pages) .	To Deputy Commissioner.
Values and description of Level Bench Marks in district Tarai (11 pages)	To Executive Engineer, Tara Canal.
Co-ordinate tables of districts Tharrawaddy and Bassein (64 pages)	To Deputy Commissioner.
Miscellaneous.	
Calculated direct distances from differences of co-ordinates of all trijunction pillars of villages in tahsil Fazilka, district Ferozepore, (60 pages) for Deputy Commissioner; prepared area statement of district Tharrawaddy according to circles by summation of village areas; revised area statements of districts Umballa, Karnal and Hissar according to tahsils; calculated lat. and long. for the projection of Hooghly River, and rectangular co-ordinates for projection of district Tavoy; prepared a statement showing area and cost of Cadastral, Topographical and Trigonometrical Surveys in Burma from 1877-78 to 1894-95; also another showing the areas of all Tea Estates in district Darjiling; and a third showing areas of districts in Lower Burma as surveyed by the Revenue Survey. Supplied 85 village plots on 16-inch scale to Settlement Officer, Raipur. Calculated ares of sheets Nos. 309, 334, 335, 336, 337, Bombay; sheets Nos. 17, 36, North-Western Provinces and Oudh; sheet No. 391, Bengal; areas of the cantonments of Sabathu, Simla, and Jutog; of Government lands in Cuttack forests, of 11 forest reserves in district Jalpaiguri. Calculated accepted and rejected portions in 250 sheets on 2-inch scale of Burma Provincial Survey; prepared statements for Annual Reports; checked Annual Statements received from Executive; and did various other miscellaneous works.	

DRAWING OFFICE, CALCUTTA.

SECTION III.—CADASTRAL.

State of publication of Cadastral Maps, on the 30th September 1896.

Districts.	Number of sheets. Maps received. Up to 30th September 1895.	Added during past 12 months.	Total up to 30th September 1896.	Maps published. Up to 30th September 1896.	By Surveyor General's Office during past 12 months.	Total to 30th September 1895.	Remaining to be published.	Remarks.
North-Western Provinces.								
Agra	2,942	...	2,942	2,942	...	2,942	...	
Azamgarh	930	...	930	930	...	930	...	(*a*) These figures are liable to alteration until publication has been completed.
Ballia	1,601	...	1,601	1,601	...	1,601	...	
Banda	3,317	...	3,317	3,317	...	3,317	...	
Basti	5,571	...	5,571	5,571	...	5,571	...	
Benares	2,052	...	2,052	2,052	...	2,052	...	
Bijnor	31	...	31	31	...	31	...	
Dehra Dun	701	...	701	701	...	701	...	
Fyzabad	14	...	14	14	...	14	...	
Garhwal	...	9,100	9,100 (*a*)	...	2,255	2,255	6,845	
Ghazipur	4,021	...	4,021	2,021	...	4,021	...	
Gorakhpur	8,615	...	8,615	8,615	...	8,615	...	
Hamirpur	2,926	...	2,926	2,926	...	2,926	...	
Jaunpur	3,583	...	3,583	3,583	...	3,583	...	
Jhansi	1,661	...	1,661	1,661	...	1,661	...	
Kumaon (Bhabar)	332	...	332	332	...	332	...	
Moradabad and Terai	4,023	...	4,023	4,023	...	4,023	...	
Muttra	1,658	...	1,658	1,658	...	1,658	...	
Mirzapur	3,794	...	3,794	3,794	...	3,794	...	
Rampur State	1,356	...	1,356	1,356	...	1,356	...	
Terai	862	...	862	862	...	862	...	
TOTALS	49,990	9,100	59,090	49,990	2,255	52,245	6,845	
Burma.								
Akyab	2,785	...	2,785	2,785	...	2,785	...	
Amherst	3,391	273	3,664	3,143	521	3,664	...	
Bassein	3,437	...	3,437	3,437	...	3,437	...	
Hanthawaddy and Pegu	4,601	...	4,601	4,601	...	4,601	...	
Henzada	1,391	...	1,391	1,391	...	1,391	...	
Kyaukse	801	...	801	801	...	801	...	
Mandalay	771	10	781	771	10	781	...	
Meiktila	699	23	772	695	27	722	...	
Mergui	1,071	...	1,071	1,071	...	1,07	...	
Minbu	...	1,384	1,384 (*a*)	...	724	724	660	
Prome	847	...	847	847	...	847	...	
Rangoon Town and Index	20	...	20	...	20	20	...	
Sagaing	2,286	...	2,286 (*a*)	680	807	1,487	799	
Tavoy	763	...	763	763	...	763	...	
Tharrawaddy	1,363	...	1,363	1,363	...	1,363	...	
Thaton	85	963	1,048 (*a*)	...	497	497	551	
Thongwa	3,749	...	3,749	3,749	...	3,749	...	
TOTALS	28,060	2,653	30,713	26,117	2,586	28,703	2,010	
Bengal and Orissa.								
Cuttack Town	...	86	86	...	86	86 (*b*)	...	(*b*) Published by order of the Board of Revenue, Lower Provinces.
Muzaffarpur	1	...	1	1	...	1	...	
Patna and Gaya	3,054	...	3,054	3,054	...	3,054	...	
Puri (Khurda Estate)	4,565	...	4,565	4,565	...	4,565	...	
Shahabad	4,924	...	4,924	4,924	...	4,924	...	
TOTALS	12,544	86	12,630	12,544	86	12,630	...	
Assam.								
Darrang	1,074	...	1,074	1,074	...	1,074	...	
Kamrup	2,218	...	2,218 (*a*)	2,210	...	2,210	8	
Lakhimpur	346	...	346	346	...	346	...	
Nowgong	1,277	...	1,277	1,277	...	1,277	...	
Sibsagar	2,050	...	2,050 (*a*)	2,042	...	2,042	8	
Sylhet	213	...	213 (*a*)	168	...	168	45	
Sylhet (Jaintia)	651	...	651	651	...	651	..	
TOTALS	7,829	...	7,829	7,768	...	7,768	61	
Central Provinces.								
Raipur	43	...	43	43	...	43	...	
TOTALS	43	...	43	43	...	43	...	
GRAND TOTALS	98,466	11,839	110,305	96,462	4,927	101,389	8,916	

Abstract of work performed during 1895-96.

Province.	Number of sheets. Examined and rendered suitable for Photo-zincography.	Traced and examined for Zincography.	Proof sheets examined previous to press order.	Coloured and subsequently examined.	Remarks.
North-West Provinces	2,054	449	2,365	...	32″=1 mile.
Burma	2,682	860	2,577	...	16″=1 "
Orissa	...	86	...	...	64″=1 "
TOTALS	5,736	1,395	4,942	...	

DRAWING OFFICE, CALCUTTA.

SECTION IV.—BENGAL PROVINCIAL.

Statement showing progress of 2-inch mapping during 1895-96.

Province.		Total No. of sheets.	Graticules projected.	Stations plotted.	Details reduced by pentagraph to 2" scale.	Names of villages, streams, etc., typed.	Outlining completed.	Footnotes, margins, etc., completed.	Examined.	Finally examined.	Sent to Photographic Office for reduction to 1" scale.	Proofs examined.	Remarks.
Orissa	Previously reported	94	67	56	60	46	48	36	29	...	...	...	(a) Increase in number of sheets owing to inclusion of Khurda and Chilka lake.
	Completed during year	30	33	31	25	34	32	22	51	58	44	28	
	TOTALS	(a) 124	100	87	85	80	80	58	80	58	44	28	
Bihar	Previously reported	...	25	22	13	12	12	...	...	...	...	...	
	Completed during year	...	27	19	(b)	...	...	...	...	...	...	...	(b) No reductions have been transferred to the fair sheets, but reductions of 4133 sheets have been made on bank post paper.
	TOTALS	...	52	41	13	12	12	...	...	...	...	...	

ENGRAVING OFFICE, CALCUTTA.

Statement showing the work performed during the year 1895-96.

TITLE OF MAP.	Number of plates.	Outline.	Number of letters.	Hills, and Ornament.	REMARKS.
ENGRAVING.					
Indian Atlas.					
Scale, 1 inch=4 miles.					
Quarter sheets, new, completed .	6	9	4,927	41	
Ditto „ in progress .	47	760	83,029	557	
Additions and corrections to published quarter sheets . .	61	212	34,154	301	
Ditto ditto full sheets	25	199	46,109	131	
General Maps	12	198	27,953	...	
Provincial Maps.					
On scale 1 inch=16 miles . .	20	817	49,444	66	
On various scales for Administration Reports	5	2	1,887	...	
District Maps.					
On various scales for Administration Reports . . .	55	271	43,224	47	
Plans	9	131	9,621	617	
Index Maps	4	23	2,730	...	
Miscellaneous subjects . .	26	775	47,495	...	
TOTALS .	270	3,397	350,573	1,562	

COPPERPLATE PRINTING.

Impressions taken	20,161
Proofs pulled	506
Transfers pulled	514
TOTAL	21,181

STEEL FACING.

Double Elephant plates,	steel	faced	16
Ditto	„	removed	23
Quarter sheets	„	faced	31
Ditto	„	removed	27
Miscellaneous plates	„	faced	75
Ditto	„	remove	32
		TOTAL	204

PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE, CALCUTTA.

Extract from the Narrative Report of COLONEL J. WATERHOUSE, S.C., *Assistant Surveyor-General, Season 1895-96.*

OUTTURN.—The work of the office generally shows a fairly large increase under almost all items, although the actual outturn from the presses, as measured in pulls, shows a decrease, as will be seen from the appended statements.

ORIGINAL SUBJECTS.—The number of original subjects under reproduction during the year was 7,020, showing an increase of 1,112 over last year. The increase is principally in the cadastral and extra-departmental work. Five hundred and eighty-two subjects have been lithographed, 46 being departmental and 536 extra-departmental, against 56 departmental and 454 extra-departmental of last year. The remaining 6,438 were reproduced by various photographic processes, or by zincography, and included 630 departmental, 4,874 cadastral, and 934 extra-departmental. The actual number of maps, etc., received during the year was 7,822, of which 682 were departmental, 5,450 cadastral, and 1,690 extra-departmental. The number completed and despatched was 7,189, of which 533 were departmental, 1,815 extra-departmental, and 4,841 cadastral.

LITHOGRAPHIC DRAWING SECTION.—The total number of new drawings or additions, etc., made to maps on stone taken up and completed during the year was 604, of which 30 were departmental and 574 were extra-departmental. Last year the number was 472, of which 41 were departmental and 431 extra-departmental. The section was under charge of Mr. H. L. Lepage until the 3rd August, when he retired on an invalid pension. He had been in weak health for some time past, but always did his work steadily and zealously, and I am very sorry to lose his services. His place has been filled up temporarily by the deputation from the Engraving Office of Mr. S. M. Coard, who had acted on previous occasions and is a most excellent assistant for the work.

LITHOGRAPHIC PRINTING SECTION.—The number of subjects printed from stone was 627, or 151 more than last year; of these, 62 were departmental and 565 extra-departmental, against 39 departmental and 437 extra-departmental of last year. The number of pulls from stone was 562,120, of which 150,158 were departmental and 411,962 extra-departmental, while the number of copies was 587,456, of which 131, 423 were departmental and 456,033 extra-departmental.

The machinery has worked well throughout the year, with the exception that the brake of the large litho. machine was accidentally broken. It was repaired at the Mint, and this caused a delay of a little over a month. The decrease in the number of pulls is partly attributable to this accident. Opportunity was taken of the recent Durga Puja holidays to have the whole of the boiler and engine thoroughly overhauled and cleaned under Mr. Coard's immediate supervision.

The section was under the charge of Mr. E. A. LeFranc till the 30th April, when he was transferred to the charge of the Zinc-Printing Section on the retirement of Mr. B. Mackenzie. Sergeant Vandyke, R.E., took his place and has done the work very satisfactorily.

ZINC-PRINTING SECTION.—The number of zinc plates printed during the year was 1,140, of which 355 were departmental and 785 extra-departmental. The number of pulls was 178,919, of which 76,445 were departmental and 102,474 extra-departmental, and of complete copies 249,171, of which 74,071 were departmental and 175,100 extra-departmental. Last year the number of plates printed was 1,242 (598 departmental and 644 extra-departmental). The number of pulls was 213,164 (97,159 departmental and 116,005 extra-departmental), and of copies 255,446 (105,477 departmental and 149,999 extra-departmental). The section was under charge of Mr. B. Mackenzie until he retired on the 30th April after a very meritorious service of 28 years. As stated above, Mr. E. A. LeFranc was appointed Head Zincographic Printer, and took charge of the section from the 1st May 1896.

CADASTRAL ZINC-PRINTING SECTION.—Four thousand nine hundred and twenty-one plates of cadastral maps of the N.-W. Provinces, Burma, and Assam were printed off during the year, the number of pulls being 121,584 and of copies of complete villages 111,430, against 4,002 plates, 146,620 pulls and 138,800 complete copies of the previous year. It will be seen that the number of plates printed off has largely increased, though the number of pulls or impressions was less. This is due to the preponderance of sheets of the N.-W. Provinces (District Garhwal), of which only a small number of copies are printed. The outturn was also diminished by a large number of sheets of District Sagaing, which had been transferred to zinc, being withdrawn and not printed off. The section was under charge of Mr. Michael till 1st May 1896, when Mr. J. B. Mackenzie took charge on being appointed to the post of Zincographer on the Cadastral establishment vacated by Mr. E. A. LeFranc, and has remained in charge ever since.

TYPE-PRINTING SECTION.—The work of this section also shows an increase in the actual work, but a falling off in the number of printed copies. The number of items set up was 11,915, of pulls 1,271,557, and of complete copies 668,795, against 11,679 items, 1,291,041 pulls, and 652,175 copies of last year. The work has been conducted satisfactorily by Mr. DePyvah.

NEGATIVE SECTION.—The number of negatives taken shows an increase of no less than 1,177 over last year, chiefly cadastral and extra-departmental, the numbers being

968 of departmental maps, 3,696 of cadastral maps, and 1,292 extra-departmental, making a total of 5,956. Last year the numbers were 1,022 departmental, 2,873 cadastral, and 884 extra-departmental, making a total of 4,779. The section has been in charge of the Head Photographic Assistant, Mr. H. Haward, all through the year. The processes in use have remained unaltered.

PHOTO-TRANSFER PRINTING SECTION.—The number of photo-transfer prints also shows a large increase, being 5,860, of which 1,020 were departmental, 3,696 cadastral, and 1,144 extra-departmental. Last year the number of prints was 4,624, of which 981 were departmental, 2,955 cadastral, and 688 extra-departmental, showing an increase of 39 departmental, 741 cadastral, and 456 extra-departmental, in all 1,236 more. The section has continued under charge of Mr. Harrold, who has devoted a good deal of time to trying methods of preparing transfers of half-tone subjects from cross-line screen negatives suitable for printing from stone or zinc. Some of the results seemed promising, but there was a difficulty in printing the plates of such delicate and at the same time close subjects.

SILVER-PRINTING SECTION.—The outturn of work in this section, both silver and blue prints, shows a falling off. The number of silver prints was 641 and of blue prints 2,428, against 652 and 3,168 of the previous year. The work in this section is, however, always more or less uncertain and fluctuating, the number of silver prints depending generally on extra-departmental demands, while the number of blue prints is regulated by departmental requirements.

The silver-printing process on plain paper (Moss') described in last year's report worked very successfully for some time, but when the supply of the sample of litho-printing paper originally used, which gave very fine results, was exhausted, great difficulty was experienced in finding a paper which would give equally good prints; Whatman's drawing paper was tried, but did not answer well, and did not give anything like the peculiar richness of tone and transparency and detail in the shadows that the original paper did. The lithographic paper now in use gives very inferior results. Plain photographic paper is better. Mr. C. J. Meade has carried on the duties of the section under the general supervision of Mr. Harrold.

HELIOGRAVURE SECTION.—The work of this section shows a very considerable increase, both in the number of plates etched and in the number of prints. The number of plates prepared by the photo-etching process was 144, or 59 more than last year, while the number of prints rose from 49,675 to 56,388, or 6,713 more than last year. The number of photo-blocks was 5, or 1 less than last year. This process, though undoubtedly very useful, as explained last year, is not very much employed, because it is found that the blocks require much more work in preparing them than the etched copper plates do, and the results after all are not so satisfactory, though they can be printed off much faster. The results we have attained are about as good as the ordinary second class work done in Europe, and to get better would require special arrangements and machines which the demand for the process does not at present seem to warrant. It seems likely that the practical solution of the quick printing of half-tone subjects will be etching from cross-lined screen plates on copper by photo-etching and transferring to stone or zinc.

If the demands for photo-etching continue to increase, as they have done this year, more presses and printing establishment will be required, unless some such method of quick printing can be introduced and worked successfully.

There have been no changes in the processes. The method of drawing on glass for colour printing has been utilised in preparing two plates of coloured diagrams and drawings showing the changes in the blood caused by cobra venom, prepared for the "Scientific Memoirs by medical officers of the army in India." The results were very successful indeed and far better for the purpose than chromo-lithographs. A copy of one of the plates is attached and the method of producing it was as follows:—

Two copper plates were prepared with a bitumen grain in the ordinary way as for photo-etching, except that the deposit of bitumen was coarser, so as to stand a much deeper biting. Upon one of these plates the red squares *forming* the ground tint in figures 5 to 16 having been outlined in pencil the intermediate spaces and parts not required to be etched were marked out with black varnish and the squares etched with a solution of perchloride of iron at a strength of 38°B. for 15 minutes. On the etched plate thus obtained the red squares were printed with a mixture of scarlet lake and vermilion. On the second plate, in the same way, the squares representing the four shades of brown used to modify the colour of the squares printed from the red plate were marked out and etched with the same strength of perchloride of iron solution for varying periods, the deepest tint taking 30 minutes and the lightest two minutes. These squares were printed in burnt umber. A certain amount of touching up with the roulette was also necessary to obtain sufficient strength and uniformity on the red squares, and for adjusting the gradations of tint on the brown squares. In the production of this part of both plates photography took no share, but was used for preparing the upper part containing figures 1 to 4.

The details in blue and pink of these figures were drawn separately on glass, as described in the Annual Report for 1892-93, and were etched after careful registration, on the two copper plates on which the squares in red and brown had already been etched, the pink portions being placed on the plate to be printed in scarlet and the blue

SPECIMEN OF PHOTO-ETCHING PRINTED IN FOUR COLORS FROM TWO PLATES.

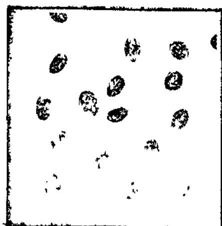


Fig. 1 × 830.

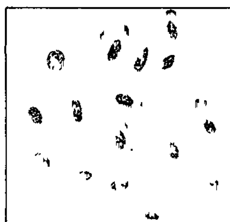


Fig. 2 × 830.

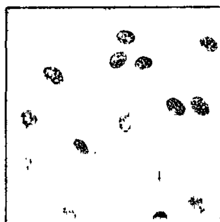


Fig. 3 × 830.

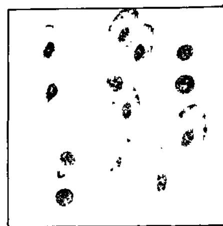


Fig. 4 × 830.





Fig. 5.

Fig. 6.






Fig. 7.

Fig. 10.





Fig. 8.





Fig. 17.






Fig. 9.






Fig. 11.






Fig. 14.






Fig. 12.





Fig. 15.






Fig. 13.





Fig. 16.

EFFECTS OF COBRA-VENOM WITHOUT & WITH ANTIVENENE & COBRA-SERUM ON THE BLOOD OF VARIOUS ANIMALS.

Chromo-Heliogravure

Survey of India Offices, Calcutta, July 1896.

parts on the plate to be printed in brown. The flat tints of pink forming the ground were afterwards etched over the image by regraining the plate with powdered bitumen, masking out with black varnish and etching with a very weak solution of perchloride of iron at 3° B., the different tints being given 5, 3, and 1 minutes respectively.

The impressions from the two plates were printed *dry* on paper specially prepared with a facing of sulphate of baryta, as described in last year's report. The outline and lettering were first printed in black by lithography; then the scarlet squares and details in pink were printed at one pull from the first copper-plate, the plate being inked up with the two inks separately, each in its own place. Finally the brown and blue tints were printed in the same way from the second copper-plate. Throughout the process the greatest care had to be taken to secure proper registration of the various colours, and the result, as shown in the annexed illustration, is certainly successful and does credit to Mr. Turner, the Photo-engraver.

The electrotyping work has gone on as usual, and also shows an increase over last year, 17 duplicates and matrices having been made against 7 of the previous year.

Mr. A. W. Turner, the Photo-engraver, went on furlough from the 10th July, and Mr. J. T. Meade officiated for him during the rest of the year and has carried on the work very satisfactorily. The large amount of work in progress has fully taken up the time of the staff, and little experimental work could be done.

PERSONAL WORK.—The increasing amount of work passing through the office leaves but little time for steady experimental work, nor has there been any important improvement to work out. I made some trials of the new method of trichromatic printing, but found that to produce anything like good results would require an amount of working up on the negatives and transparencies which would make the process almost prohibitive in practice, and as it is not likely to be of any great use to us, it did not seem worth spending more time upon.

During the past five years, there has not been any very marked increase in the outturn of the presses and machines, though more work seems to come in, and at certain seasons it is most difficult to get through the many urgent demands with all available appliances, so that another lithographic printing machine for plates of imperial size would be a great help, especially in turning out more coloured work, much of which has to be done by hand. It would also be desirable to get out a new boiler for the engine before long, not only to replace the present one when worn out, but also because great inconvenience is often caused by the want of water whenever the boiler has to be cleaned, as the steam-pump connected with it, which supplies the whole office with water, is thrown out of use at such times; and if any accident should happen, necessitating heavy repairs and taking time, the work of the office would be entirely stopped till they could be completed.

As this is the last Annual Report I shall have the honour of submitting, I desire to express my warm acknowledgments to my staff of assistants, European and native, and my high appreciation of the value of their services in carrying on the duties of the office, often under great difficulties, as well as the ready assistance I have always received from them. The working power of the office depends almost entirely on the staff, and I deem myself exceedingly fortunate during my long service in the office to have had such steady and good subordinates and so few bad ones. It has been a great pleasure to work with them so many years, and I shall leave them with very great regret.

PHOTOGRAPHIC AND

Abstract of Departmental work

Specification.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic and Lithographic Printing.					Number of Copies.		
			Photo-transfer prints.	Zinc plates transferred.	Zinc plates, printed.	Stones.	Pulls.	Coloured.	Uncoloured.	Total.
Departmental Maps and Plans, etc.										
General Maps	21	23	23	8	30	18	7,200	725	2,500	3,225
Provincial Maps	1	...	...	...	6	13	2,858	200	758	958
Divisional Maps	8	8	8	2	...	...	...	...	...	...
District Maps	54	103	103	35	23	15	5,875	...	5,675	5,675
Plans of Cities and Cantonments	28	46	37	17	42	...	3,650	...	3,650	3,650
Standard Maps	332	472	458	166	119	3	19,880	...	19,888	19,888
Index Maps	45	43	43	59	67	5	37,125	30,900	4,200	35,100
Atlas sheets	1	...	..	...	...	...	...	...	...	...
Technical Charts	2	8	33	10	6	...	200	...	200	200
Miscellaneous Maps, etc.	168	265	315	52	56	17	14,143	60	15,113	15,173
Transfers and Proofs	...	...	...	...	...	...	2,447	...	...	...
Departmental Forms	16	...	...	...	6	15	133,225	...	121,625	121,625
Type printings	...	...	...	...	...	...	...	...	...	...
Totals	676	968	1,020	349	355	86	226,603	31,885	173,609	205,494
Cadastral Maps.										
North-Western Provinces—										
Photo-zincographs	1,951	1,951	1,925	1,911	1,911	...	25,574	...	25,574	25,574
Zincographs	398	...	...	398	398	...	5,174	...	5,174	5,174
Totals	2,349	1,951	1,925	2,309	2,309	...	30,748	...	30,748	30,748
Burma—										
Photo-zincographs	1,745	1,745	1,771	1,831	1,831	...	56,416	...	56,416	56,416
Zincographs	780	...	...	780	780	...	24,213	...	24,213	24,213
Totals	2,525	1,745	1,771	2,611	2,611	...	80,629	...	80,629	80,629
Assam—										
Photo-zincographs	...	...	...	1	1	...	53	...	53	53
Zincographs	...	...	...	...	...	...	...	...	...	...
Totals	...	...	...	1	1	...	53	...	53	53
Transfers and Proofs	...	...	...	...	...	...	10,154	...	...	...
GRAND TOTALS	4,874	3,696	3,696	4,921	4,921	...	121,584	...	111,430	111,430

LITHOGRAPHIC OFFICE.

done during the year 1895-96.

Type Printing.			Silver and other Printing.		Heliogravure and Electrotyping.				Value.	Remarks.
Pages or items.	Pulls.	Copies.	Silver-prints.	Blue prints.	Heliogravure plates.	Heliogravure prints.	Photo-blocks.	Electrotypes.		
									R a. p.	
...	...	...	...	...	...	...	...	...	2,146 12 3	
...	...	...	...	...	...	...	...	...	916 4 6	
...	...	...	...	...	...	...	...	...	100 3 3	
...	...	...	...	312	...	...	...	...	6,507 11 6	
...	...	...	...	20	...	...	...	...	1,710 13 9	
...	...	...	...	1,427	...	...	...	...	16,237 6 6	
...	...	...	...	179	...	...	...	...	3,215 2 3	
...	...	...	...	...	...	...	...	...	90 0 0	
...	...	...	...	...	...	...	...	...	349 11 6	
...	...	...	69	105	18	2,018	...	17	9,425 15 3	
...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	13,246 3 0	
11,915	1,271,557	668,795	...	...	...	...	...	...	17,223 10 6	
11,915	1,271,557	668,795	69	2,043	18	2,018	...	17	71,169 14 3	
...	...	...	...	...	...	...	...	...	25,283 6 6	
...	...	...	...	...	...	...	...	...	2,327 13 6	
...	...	...	...	...	...	...	...	...	27,611 4 0	
...	...	...	...	...	...	...	...	...	28,046 10 0	
...	...	...	...	...	...	...	...	...	6,574 0 9	
...	...	...	...	...	...	...	...	...	34,620 10 9	
...	...	...	...	...	...	...	...	...	12 12 0	
...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	12 12 0	
...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	62,244 10 9	

PHOTOGRAPHIC AND

Statement of Work done for other

Departments, etc.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic and: Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Stones.	Pulls.
Adjutant General in India	8	...	...	...	4	6	9,460
Agent to the Governor-General, Central India and Rajputana	...	...	...	...	2	1	210
Agent, Indian Midland Railway	1	...	...	...	1	2	150
Agent and Chief Engineer, Bombay, Baroda and Central India Railway	1	1	1	1	1	...	30
Agent and Chief Engineer, Bengal and North-Western Railway	65	64	64	35	35	...	3,650
Agent and Chief Engineer, Southern Punjab Railway	46	...	...	...	18	9	1,080
Amritsar Municipality	3	...	...	...	4	...	400
Archæological Surveyor, North-Western Provinces and Oudh	...	...	101	26	26	...	13,000
Architectural Surveyor, North-Western Provinces and Oudh	64	64	63	12	23	14	6,850
Assistant Adjutant General, Mhow District	2	4	4	1	1	...	300
Asiatic Society, Bengal	10	8	...	...	...	1	40
Board of Revenue, Bengal	3	...	...	...	...	21	1,724
" North-Western Provinces and Oudh	12	25	53	14	8	...	1,800
Brigadier General Commanding Hyderabad Contingent	1	...	...	...	...	1	100
Calcutta Municipality	16	49	45	15	32	5	5,980
Chief Commissioner, Assam	1	...	...	...	...	1	6,000
" Burma	...	...	...	...	6	...	72
" Central Provinces	...	...	...	...	...	1	400
Chief Engineer, Bengal, Public Works Department	50	83	83	27	30	9	7,655
" Irrigation Works, Punjab	10	6	5	5	3	2	9,500
" Indian Midland Railway	1	...	...	...	...	2	300
" Punjab, Public Works Department	5	4	4	2	3	4	1,430
Colonial Secretary, Straits Settlements	39	72	72	39	40	...	6,000
Collector of Customs, Calcutta	7	...	...	...	...	10	5,100
Commissioner, Ajmere-Merwara	...	...	...	...	1	...	25
" Chittagong	1	...	...	...	...	1	50
" Chota Nagpur	...	...	...	2	2	...	210
" Excise, Bengal	4	...	...	...	4	4	1,960
" " Punjab	2	...	...	...	3	1	860
" Police, Calcutta	...	...	...	...	...	2	2,128
" Salt, Abkari, etc., Madras	...	...	...	...	...	1	370
Commissary General-in-Chief	...	...	...	...	1	...	10
Conservator of Forests, Assam	1	...	...	...	...	1	200
" " Bengal	4	2	...	...	...	1	30
" " Tenasserim Circle	2	1	1	1	7	...	88
Consulting Engineer to the Government of India for State Railways, Public Works Department	22	23	23	12	13	5	7,620
Deputy Adjutant General, Bengal	3	2	2	1	2	2	420
" " Punjab Command	4	8	8	4	6	...	764
" Assistant Adjutant General, Peshawar District	...	...	...	...	2	...	200
" " " " Rawalpindi District	...	...	...	...	5	...	712
" " Quarter Master General, Burma	5	10	10	5	11	...	695
Deputy Collector, Darjeeling	1	2	2	1	1	...	55
Deputy Commissioner, Gurgaon	2	8	8	2	2	...	100
" " Ludhiana	1	...	...	...	...	...	...
" Conservator of Forests, Bombay	10	5	5	1	1	...	30
" Post Master General, Assam	1	...	...	...	...	2	150
Dewan, Feudatory State, Raigarh	...	...	...	...	...	...	300
Director General of Military Works	13	31	31	16	16	...	2,750
" " Post Offices, Bengal	1	...	...	...	...	2	50
" " Telegraphs	13	...	...	...	...	13	6,150
Director, Geological Survey of India	26	13	8	2	3	3	3,250
" Land Records and Agriculture, Assam	...	...	...	...	...	...	...
" " " Bengal	24	...	...	...	2	30	13,825
" " " Burma	30	66	66	30	...	...	72
" " " Gwalior State	...	...	...	...	1	...	1,000
" " " Punjab	1	...	...	...	...	1	1,000
" Government Records	24	24	...	...	...	...	...
" Military Education in India	1	...	...	...	6	4	3,600
" Public Instruction, Bengal	4	...	...	...	...	4	2,340
" Royal Indian Marine	19	30	...	...	...	...	...
Engineer-in-Chief, Assam-Burma Railway	8	12	12	9	10	2	1,420
" Eastern-Bengal State Railway	6	...	...	...	...	4	280
" East Coast Railway	7	7	7	4	4	...	55
" Ghaziabad-Moradabad Railway	1	...	...	...	5	7	25,368
" Goona, Barah and Kotah Railway	1	...	...	...	...	2	400
Carried over	587	624	678	267	345	181	159,768

LITHOGRAPHIC OFFICE.

Departments during the year 1895-96.

Lithographic Printing.			Silver and other Printing.		Heliogravure and Electrotyping.				Value.		
Number of copies.											
Coloured.	Uncoloured.	Total.	Silver prints.	Blue prints.	Heliogravure plates.	Heliogravure prints.	Photo-blocks.	Electrotypes.	R	a.	p.
1,240	10,260	11,500	...	...	...	...	...	...	632	10	0
70	...	70	...	...	...	...	...	...	88	6	0
50	...	50	...	...	...	...	...	...	92	5	0
...	30	30	...	...	...	...	...	...	14	8	9
...	6,650	6,650	...	...	...	...	...	...	1,753	15	0
...	1,896	1,896	...	...	...	...	...	...	579	12	0
...	300	300	...	...	...	...	...	...	266	0	0
...	50,500	50,500	...	...	...	550	...	...	2,740	15	9
...	19,150	19,150	41	192	...	950	...	...	1,894	6	9
...	300	300	...	...	...	...	...	...	167	9	6
...	40	40	9	...	1	1,311	...	...	244	3	3
674	690	1,364	...	...	...	...	...	...	291	9	0
...	1,800	1,800	...	50	...	...	...	...	1,114	14	6
...	100	100	...	...	...	...	...	...	154	0	0
650	1,755	2,405	...	4	...	...	...	...	1,868	1	0
...	6,000	6,000	...	...	...	...	...	...	200	15	0
...	72	72	...	...	...	...	...	...	25	11	3
...	400	400	...	...	...	...	...	...	24	3	0
970	8,195	9,165	...	...	...	...	...	...	2,704	15	6
...	14,750	14,750	...	...	1	1	...	...	982	6	6
150	...	150	...	...	...	...	...	...	58	8	0
...	1,160	1,160	...	...	...	...	...	...	952	7	0
...	6,000	6,000	...	...	...	...	...	...	2,366	11	9
3,570	...	3,570	...	...	...	...	...	...	564	14	0
...	25	25	...	...	...	...	...	...	2	11	6
...	50	50	...	...	...	...	...	...	21	1	0
...	105	105	...	...	...	...	...	...	21	6	0
1,960	...	1,960	...	...	...	...	...	...	227	14	0
430	...	430	...	...	...	...	...	...	71	8	0
1,064	...	1,064	...	...	...	...	...	...	133	12	0
...	370	370	...	...	...	...	...	...	56	6	0
...	10	10	...	...	...	...	...	...	5	3	6
...	200	200	...	...	...	...	...	...	30	0	0
...	60	60	...	2	...	...	...	...	47	4	0
...	56	56	...	...	...	...	...	...	255	7	0
1,200	8,620	9,820	...	...	...	...	...	...	1,166	6	3
...	420	420	...	...	...	...	...	...	246	0	3
...	764	764	...	...	...	...	...	...	352	8	9
...	100	100	...	...	...	...	...	...	35	6	6
...	612	612	...	...	...	...	...	...	218	2	0
...	695	695	...	...	...	...	...	...	284	5	9
...	55	55	...	...	...	...	...	...	50	14	0
...	100	100	...	...	...	...	...	...	137	6	0
...	...	...	...	...	...	...	...	...	80	0	0
...	30	30	...	5	...	...	...	...	67	12	9
...	75	75	...	...	...	...	...	...	404	5	0
...	300	300	...	...	...	...	...	...	54	2	0
...	4,700	4,700	...	...	...	...	...	...	1,190	3	3
...	25	25	...	...	...	...	...	...	265	12	0
...	7,390	7,390	...	...	...	...	...	...	1,022	9	0
600	1,450	2,050	...	2	4	3,175	...	...	1,300	6	0
...	...	...	...	...	...	...	...	...	20	10	3
7,225	3,200	10,425	...	...	...	...	...	...	2,739	9	9
...	72	72	...	...	...	...	...	...	1,094	8	0
...	1,000	1,000	...	...	...	...	...	...	186	3	0
...	1,000	1,000	...	...	...	...	...	...	29	6	0
...	...	...	...	...	12	12,012	...	...	1,987	3	0
500	900	1,400	...	...	...	...	...	...	322	7	0
2,340	...	2,340	...	...	...	...	...	...	163	15	0
...	...	...	...	...	12	3,012	...	...	1,412	4	0
...	1,060	1,060	...	...	...	...	...	...	449	11	6
420	...	420	...	...	...	...	...	...	94	4	0
...	75	75	...	...	...	...	...	...	112	4	3
5,684	...	5,684	...	...	...	...	...	...	1,992	11	0
...	200	200	...	...	...	...	...	...	78	5	0
28,797	163,767	192,564	50	255	30	21,011	...	...	38,216	1	6

PHOTOGRAPHIC AND

Statement of Work done for other

Departments, etc.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic and				
			Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Stones.	Pulls.
Brought forward	587	624	678	267	345	181	159,768
Engineer-in-Chief, Kotri-Rohri Railway	33	33	33	17	18	...	910
" North Western Railway	4	...	...	...	...	...	...
Examiner of Accounts, Eastern Bengal State Railway	1	...	...	...	...	1	200
Examiner, Telegraphic Accounts	2	1	1	1	1	...	200
Executive Engineer, Military Works, Bareilly Division	2	...	...	...	...	1	30
" Umballa Water Works	10	10	10	5	5	...	500
General Officer Commanding Assam District	4	8	8	4	4	...	108
" " " Lahore District	2	8	8	2	1	...	120
" " " Meerut District	1	2	2	1	2	...	70
" " " Punjab Frontier Force	5	11	11	5	11	1	345
Government of India, Revenue and Agricultural Department	90	64	...	5	8	15	11,669
Government of India, Finance and Commerce Department	1	...	...	...	...	2	850
" " Foreign Department	64	58	31	20	45	15	1,975
" " Home Department	1	...	...	...	3	...	650
" " Military Department	6	3	3	3	3	5	2,225
" " Public Works Department	63	39	39	25	24	37	21,134
" Bengal, Revenue and General Department	8	1	...	...	11	6	28,838
" " Financial Department	2	...	...	...	...	2	686
" " Judicial and Political Department	4	...	...	...	3	3	1,540
" " Marine Department	9	...	...	...	...	...	...
" " Public Works Department, Irrigation Branch	26	52	8	4	9	7	3,550
Government of Punjab, Public Works Department	1	4	4	2	2	...	204
" Epigraphist, Madras	12	7	5	4	3	...	2,085
Indian Museum	16	18	...	...	...	...	...
Inspector General of Artillery in India	23	2	2	2	5	5	5,670
" " Civil Veterinary Department	1	...	...	...	4	3	2,120
" " Forests and Plantations, Mysore	1	8	8	3	3	...	90
" " Imperial Service Troops	1	...	...	...	...	3	300
" " Jails, Bengal	4	...	...	...	...	1	20
" " of Police, Bengal	12	3	...	...	...	7	3,780
" " Registration, Bengal	...	...	...	...	...	3	1,494
Magistrate, Bogra	1	...	...	...	...	1	50
Manager, Burma State Railway	1	...	...	...	...	1	1,500
" Eastern Bengal State Railway	2	1	1	1	1	1	120
" North Western Railway	1	...	...	...	1	...	3,150
Meteorological Reporter, Bengal	1	...	...	...	1	...	9,600
" " India	122	1	1	...	35	47	158,210
Mint Master, Calcutta	1	1	...	...	1	...	12
Officer Commanding 5th Lancers, Mathura	...	...	...	4	4	...	200
" Quetta District	1	2	2	1	1	...	60
Photographic Society, India	4	5	...	...	...	...	...
Port Commissioners, Calcutta	15	45	45	15	18	...	1,790
Port Officer and Registrar of Wrecks, Calcutta	2	8	8	2	1	4	672
President, Labor Commission, Bengal	2	...	...	...	...	2	200
Principal, Civil Engineering College, Sibpur	23	22	16	5	5	3	3,500
" Dacca College	...	...	...	...	...	...	100
Private Secretary to His Excellency the Viceroy	...	...	...	2	2	...	110
Quarter Master General in India	30	28	1	1	21	2	1,520
Reporter on Economic Products to the Government of India	...	...	...	...	...	...	...
Resident Engineer, Patiala State	...	...	...	...	1	1	1,000
Revenue Surveyor, Batu Gajah, Perak, Straits Settlements	18	8	8	2	...	...	...
Royal Survey Department, Siam	29	110	138	55	74	...	4,150
Sanitary Commissioner, Assam	1	...	...	...	...	1	300
" " Bengal	7	...	...	...	...	10	6,540
" " Central Provinces	...	...	...	...	1	...	275
" " Hyderabad Assigned Districts	11	...	...	...	...	6	1,200
" " India	3	...	...	...	...	6	4,300
" " North-Western Provinces and Oudh	2	...	...	...	...	3	1,140
Sarun Municipality	1	...	...	...	...	1	100
Secretary for Berar to the Resident at Hyderabad	...	...	...	1	1	...	195
" Central Examination Committee, Calcutta	1	1	2	...	...	...	...
" His Highness the Nizam's Government	...	...	...	...	12	2	5,150
" Lady Dufferin's Fund	1	2	...	...	...	2	3,000
" of State for India	2	8	8	2	2	...	140
Carried over	1,278	1,198	1,081	461	692	391	459,415

LITHOGRAPHIC OFFICE.

Departments during the year 1895-96—contd.

Lithographic Printing.			Silver and other Printing.		Heliogravure and Electrotyping.				Value.		
Number of copies.											
Coloured.	Uncoloured.	Total.	Silver prints.	Blue prints.	Heliogravure plates.	Heliogravure prints.	Photo-blocks.	Electrotypes.	R	a.	p.
28,797	163,767	192,564	50	255	30	21,011	...	...	38,216	1	6
...	1,700	1,700	...	...	...	...	...	...	574	4	9
...	...	...	...	...	...	...	...	...	525	0	0
...	200	200	...	...	...	...	...	...	17	3	0
...	400	400	...	...	...	...	...	...	22	7	3
...	30	30	...	...	...	...	...	...	214	2	0
...	1,000	1,000	...	...	...	...	...	...	209	7	9
...	108	108	...	...	...	...	...	...	163	3	6
...	120	120	...	...	...	...	...	...	130	4	6
...	70	70	...	...	...	...	...	...	42	6	0
...	345	345	...	...	...	...	...	...	282	5	0
2,460	3,519	5,979	...	64	19	15,819	...	...	4,715	5	3
...	850	850	...	...	...	...	...	...	59	3	0
6	1,746	1,752	90	...	27	27	...	...	3,349	11	3
...	650	650	...	...	...	...	...	...	307	6	0
200	1,825	2,025	...	...	...	...	...	...	217	8	0
3,846	13,133	16,979	...	...	1	151	...	...	5,120	15	0
17,046	5,312	22,358	7	...	1	1	...	...	1,391	0	6
686	...	686	...	...	...	...	...	...	34	11	0
...	930	930	...	...	...	...	...	...	204	15	9
...	...	...	...	...	...	...	...	...	75	0	0
900	2,300	3,200	...	132	...	...	...	...	1,430	13	9
...	204	204	...	...	...	...	...	...	128	11	0
...	2,085	2,085	14	...	2	1,402	...	...	504	15	0
...	...	...	30	...	10	1,270	...	...	590	8	0
200	18,070	18,270	...	...	...	...	...	...	487	6	0
300	620	920	...	...	...	...	...	...	174	10	0
...	90	90	...	...	...	...	...	...	153	1	0
100	...	100	...	...	...	...	...	...	76	11	0
...	80	80	...	...	...	...	...	...	69	11	0
2,700	...	2,700	...	7	...	...	5	...	262	11	6
498	...	498	...	...	...	...	...	...	155	7	0
...	50	50	...	...	...	...	...	...	39	14	0
...	1,500	1,500	...	...	...	...	...	...	164	2	0
...	120	120	...	...	...	...	...	...	95	10	0
...	6,300	6,300	...	...	...	...	...	...	335	15	0
...	9,600	9,600	...	...	...	...	...	...	118	13	0
22,295	223,050	245,345	...	...	...	...	...	...	6,867	13	0
...	12	12		..	...	...	...	...	12	6	3
...	100	100	...	...	...	...	..	...	81	3	6
...	60	60	...	...	...	...	...	...	48	1	9
...	...	...	...	...	4	7,304	...	...	546	0	0
...	1,790	1,790	...	...	...	...	...	...	1,205	6	6
140	252	392	...	...	...	...	...	...	287	9	6
...	200	200	...	...	...	...	...	...	134	0	0
...	6,650	6,650	...	6	...	100	...	...	833	4	0
...	100	100	...	...	...	...	...	...	25	0	0
...	55	55	...	...	...	...	...	...	33	3	3
40	1,490	1,530	...	27	...	...	...	...	512	3	0
...	...	...	2	...	...	...	...	...	1	0	9
...	1,000	1,000	...	...	...	...	...	...	85	9	0
...	...	...	...	...	...	...	...	...	108	0	0
...	4,150	4,150	...	...	...	...	...	...	3,295	0	9
...	300	300	...	...	...	...	...	...	43	0	0
3,550	860	4,410	...	...	...	...	...	...	464	13	0
...	275	275	...	...	...	...	...	...	35	8	0
...	2,200	2,200	...	...	...	...	...	...	330	11	0
950	2,400	3,350	...	...	4	504	...	...	710	2	0
380	380	760	...	...	...	...	...	...	155	4	0
...	100	100	...	...	...	...	...	...	32	7	0
...	390	390	...	...	...	...	...	...	12	13	0
...	...	...	...	...	...	...	...	...	14	0	0
...	5,125	5,125	...	...	...	...	...	...	1,422	12	0
1,500	...	1,500	...	...	1	1,504	...	...	364	14	0
...	140	140	...	...	...	...	...	...	177	4	3
86,594	487,803	574,397	194	491	99	49,093	5	...	78,506	13	9

Statement of Work done for other

Departments, etc.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic and				
			Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Stones.	Pulls.
Brought forward	1,278	1,198	1,081	461	692	391	459,415
Station Staff Officer, Sialkot	1	2	2	1	1	...	100
Superintendent, Government Printing, India	132	52	51	25	48	31	22,745
" " " Bengal	1	...	...	...	...	2	303
" " " Burma	26	26	...	...	...	...	...
" Campbell Hospital Medical School	...	...	...	...	...	1	36
" Forest Surveys, Dehra Dun	1	...	...	16	15	3	3,840
" Land Records, Tharrawaddy	...	...	...	...	1	...	150
" Presidency Jail, Calcutta	3	...	...	...	...	3	3,000
" Stationery, "	1	...	...	...	5	2	7,704
" Telegraphic Stores	1	...	...	...	1	...	1,100
Superintending Engineer, 1st Circle, Punjab	3	6	6	3	3	...	90
" " 2nd " "	2	2	2	2	2	...	100
" " Hyderabad, Public Works Department	4	...	...	...	4	...	80
Traffic Superintendent, Eastern Bengal State Railway	1	...	...	...	...	1	50
Special Work done for Trade and Private Individuals	19	6	2	4	13	9	14,588
Transfers and Proofs	...	...	...	...	...	...	1,135
Totals	1,470	1,292	1,144	512	785	443	514,436

LITHOGRAPHIC OFFICE.

Departments during the year 1895-96—concld.

Lithographic Printing.			Silver and other Printing.		Heliogravure and Electrotyping.				Value.		
Number of copies.											
Coloured.	Uncoloured.	Total.	Silver prints.	Blue prints.	Heliogravure plates.	Heliogravure prints.	Photo-blocks.	Electrotypes.	R	a.	p.
86,594	487,803	574,397	194	491	99	49,093	5	...	78,506	13	9
...	100	100	...	...	...	...	...	...	56	11	3
2,112	25,195	27,307	26	1	...	...	...	...	3,178	14	0
...	303	303	...	...	...	...	...	...	74	0	0
...	...	...	...	...	26	5,226	...	...	1,556	0	0
...	36	36	...	...	...	...	...	...	6	0	0
230	1,890	2,120	...	...	...	...	...	...	266	1	0
...	150	150	...	...	...	...	...	...	37	8	0
...	3,000	3,000	...	...	...	...	...	...	186	7	0
...	7,704	7,704	...	...	...	...	...	...	395	12	9
...	1,100	1,100	...	...	...	...	...	...	56	2	0
...	90	90	...	...	...	...	...	...	128	0	6
...	100	100	...	...	...	...	...	...	62	3	6
...	20	20	...	...	...	...	...	...	297	1	0
...	50	50	...	...	...	...	...	...	114	7	0
960	12,764	13,724	238	7	1	51	...	...	1,442	4	9
...	932	932	...	...	...	...	...	...	...		
89,896	541,237	631,133	458	499	126	54,370	5	...	86,364	6	6

MATHEMATICAL INSTRUMENT OFFICE.

TABLE A.

Details of Issues to and Receipts from Provinces and Departments during 1895-96.

Provinces and Departments.	Value of			
	Receipts.	Issues.	Debits.	Credits.
	R	R	R	R
Assam	189	5,048	4,859	...
Bengal Civil	10,220	57,860	47,640	...
Bengal Military, Bengal Command	451	3,625	3,174	...
" " Punjab "	4,370	13,454	9,084	...
Bombay Civil	...	96	96	...
" Military	334	1,345	1,011	...
Burma	6,357	38,670	32,313	...
Central Provinces	2,191	9,372	7,181	...
Foreign States, Berar	...	617	617	...
Forests	2	3,007	3,005	...
Geological Survey and Museums	176	225	49	...
Inland Customs	...	89	89	...
Law and Justice, Port Blair	...	83	83	...
Land Revenue	...	70	70	...
Madras Military	2,017	1,196	...	821
" Civil	8,803	20,264	11,461	...
Marine	33	875	842	...
Meteorological Department	299	2,622	2,323	...
North-Western Provinces and Oudh	2,273	21,651	19,378	...
North-Western State Railway, Public Works Department	...	1,023	1,023	...
Public Works Department, Military Works	2,436	2,703	267	...
Public Works Department, Baluchistan, Railway Branch	7,880	2,866	...	5,014
Public Works Department, East Indian Railway	105	38,128	38,023	...
Public Works Department, Madras and Coorg	...	52	52	...
Punjab	3,988	13,369	9,381	...
Rajputana Public Works Department and Central India	1,093	2,113	1,020	...
State Railway Stores, Public Works Department	81	...	...	81
Special Political—				
Afghan Boundary Commission	50	...	...	50
Waziristan Delimitation Commission	92	...	...	92
Survey Department (Field Parties)	50,814	74,520	23,706	...
Ditto ditto, Head-Quarters Offices, Calcutta and Dehra Dun	4,708	14,754	10,046	...
Telegraph Department	...	156	156	...
TOTAL	1,08,962	3,29,853	2,26,949	6,058
NET DEBIT	...	...	2,20,891	...
CASH SALES	...	...	42,753	...
GRAND TOTAL	...	...	2,63,644	...

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the local market during 1895-96.

SPECIFICATION.	No.	Value.	
INSTRUMENTS.		R	a.
Arithmometers, French	2	854	8
Cases, leather and morocco, spare	136	476	0
Chains, measuring, iron, 66 feet	100	350	0
" steel	3	51	0
" of sorts and sizes	5	113	9
Chrono-micrometers	2	220	0
Clocks	2	80	0
Clinometers, Watkin's pattern	15	447	0
Compasses, bow ink, double jointed electrum	6	51	0
" drawing, ordinary, 5-inch	510	573	12
" magnetic, pocket, in brass case	3	142	8
" " rectangular, 2½-inch	12	84	0
" " " 5-inch	72	936	0
" " " 6-inch	85	1,215	0
Covers for plane-tables	98	564	4
Glasses, binocular, large	11	603	8
" " small	34	1,334	8
Ghât tracers, Ceylon pattern	3	152	10
Haversacks	50	75	0
Instruments, drawing, brass, 1st sort	4	272	8
" " " 2nd "	10	487	8
" " " 3rd "	3	72	0
" " electrum, 1st sort	1	80	0
" " " 1st " with needle points	3	260	0
Lamps, Argand	3	7	8
" Bull's eye	12	25	8
Levels, reflecting, Abney's	4	207	8
" reversible, 14-inch	2	635	0
" spirit, in wooden cases, 8 x 10-inch	100	243	0
Map-printing machines, Gastrell's	3	187	8
" " Ordnance	12	555	0
Chronographs, watch pattern	20	500	0
Pens, bordering	6	34	8
Pens, drawing, ivory handles	50	125	0
Pens, double or road	8	79	0
Pins for chains, ordinary	8,000	500	0
Plane-tables, deal, Survey pattern	39	273	0
Protractors, rectangular, ivory, 6-inch	72	364	8
" " wooden	60	112	8
Range-finders	2	166	1
Rules, parallel, on rollers, brass, 9-inch	2	50	0
" " " " 12-inch	3	54	0
" " " " 18-inch	9	294	0
" " " " 2-feet	4	160	0
" " " " 2½-feet	6	468	0
" " " " 3½-feet	2	236	0
" sight, wooden	681	2,043	0
Scales, architects, boxwood, single	12	45	0
" " ivory universal, 12-inch	1	9	12
" diagonal wooden	500	281	4
" offsets, single, ivory	902	451	0
" " " wooden	50	18	12
" plotting, sets, wooden	8	76	8
" " single, wooden	206	925	4
Sextant, nautical	1	125	0
Set squares, sets, ebonite	62	543	0
Squares, optical	830	5,395	0
Carried over	12,842	24,687	4

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the local market during 1895-96—contd.

Specification.	No.	Value. R a.
Brought forward	12,842	24,687 4
Stands for level, dumpy and Y	2	100 0
" " plane-table, Survey pattern	825	5,775 0
" " theodolites, 6-inch, Explorers	3	240 0
" " " transit, Railway	1	65 0
Staves, levelling, telescopic, Sopwith's	100	1,525 0
Sheets, celluloid	620	193 12
Stencil plates, various	8	9 0
Tapes, measuring, metallic, 50 feet	225	1,068 12
" steel, other sizes	1	13 8
Telescopes of various sorts	1	95 0
Theodolite, transit, with complete vertical circle, without illuminating apparatus, 6-inch	3	2,220 0
Theodolite, transit, without vertical circle, Railway, 6-inch	1	520 0
Thermometers, maximum, self-registering	6	96 0
" minimum "	6	96 0
Tramel heads for beam compass	1	35 0
Umbrellas, surveying	25	375 8
TOTAL	14,670	37,114 12
Books.		
Hints to Travellers	3	19 8
Manual of Surveying	3	36 0
Nautical Almanacs	98	196 12
Navigation, Norie's	1	14 4
Tables, Log., Hutton's	6	54 0
" Shortrede's Sines, etc.	4	121 14
" traverse, Boileau's	12	108 0
" " Gurden's	3	47 4
TOTAL	130	597 10
Sundries.		
Brushes, stencil, medium size	48	23 4
Acme Duplicator complete	1	20 0
Asbestos mill-board, 8-inch thick	1	10 8
Badges, brass, for shoulders	160	80 0
" " for chaprasis	40	100 0
Brass boxes for rectangular compasses, 5-inch and 6-inch	100	1,250 0
Black record pad for Yost type-writer	1	9 0
Brass weight, sets	2	13 12
Bray's burners	2	0 12
Brass stamp	1	2 0
Centre punch and calliper, 5-inch	2	3 4
Compass, spring divider	1	2 4
Frames and fittings for chronometers	36	534 0
" " for folding sights	16	364 0
Glass lubricators	12	15 0
Gauge glass for lubricators	12	9 0
Rings, rubber, for "	24	2 0
Carried over	459	2,438 12

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the local market during 1895-96—contd.

Specification.	No.	Value. R a.
Brought forward	459	2,438 12
Globes	2	3 0
Glass holders	2	1 0
Glass circle, silvered	24	3 0
Glass ink-bottles	127	39 4
Leather bags	6	30 0
Microscopes, flat	1	8 0
Minner's distance measure	1	230 0
Scales, letter-weighing	4	45 2
" parcel-weighing, with weights	1	23 0
Stencil ink	27	14 4
Steelyards to weigh 350 lbs.	1	35 0
Thermometers, maximum and minimum, with magnets	2	18 0
" Sykes', with magnets	8	112 0
Types, leaden, for conventional signs	36	36 12
Type-writing machine complete	1	484 0
Screws and screw making, Godfray's Treatise on Astronomy, and Russell's Meteorology	3	30 10
TOTAL	705	3,551 12
TOTAL OF BOOKS	130	597 10
" OF INSTRUMENTS	14,670	37,114 12
SUM TOTAL	15,505	41,264 2

MATHEMATICAL INSTRUMENT OFFICE.

TABLE C.

Instruments, etc., manufactured in the Mathematical Instrument Office during 1895 96.

Specification.	Number.	Value. R	a.
Instruments.			
Bars, standard, steel	8	254	0
Boards, drawing, deal	72	887	0
Chains, measuring, iron, 30 feet	232	580	0
" " " 66 "	409	1,431	8
" " " 100 "	170	1,187	0
" steel	165	1,735	0
" of sorts and sizes	65	245	0
Clinometers, survey pattern	36	1,360	0
" wooden, with shade scale	24	36	0
Combs, acre, cardboard	5,200	1,950	0
" " metal	1	12	0
Compasses, magnetic, recangular, 4-inch	24	240	0
" " " 6-inch	30	480	0
Glasses, copying and tracing	21	735	8
Lamps, bull's eye	3	18	0
" referring	24	132	0
Levels, field service	6	192	0
Hold-alls, leather	134	2,419	0
Pins for chains, ordinary	5,000	625	0
Plane-tables, deal, survey pattern	405	2,755	0
Plates, graticule	2	130	0
Pluviometers, Symon's, 5-inch	105	670	0
Protractors, cardboard, circular, 9 and 12-inch	50	18	12
Rods, measuring	154	308	0
Rules, flat, wooden, plain, 12-inch	38	7	2
Rules, sight, brass	42	564	0
Scales, cardboard, miscellaneous	300	75	0
" diagonal, cardboard	8,200	2,075	0
Scales, diagonal, metal, 12-inch to the mile	1	8	0
" " " miscellaneous	72	720	0
Sheets, celluloid	2,428	1,495	8
Scales, plotting, single, wooden	12	24	0
Stamps for conventional signs	60	147	0
Stands for heliotropes	22	316	0
Stands for plane-tables, Survey pattern	95	665	0
Staves, cross, or offsets	33	165	0
" levelling, Roorkee, double	25	625	0
" " " single	26	364	0
" " Sopwith's telescopic	72	1,786	0
Stencil plates, various	309	741	8
TOTAL	24,075	28,178	14
Sundries.			
Boxes of sorts	27	43	0
Backboard for barometer	1	15	0
Box, deal, for rule sight	1	2	0
Brass plates for plane-tables	3	4	8
Brass top for rain-gauge	6	27	0
Clamping screws	4	8	0
Exchange calculating machine	1	50	0
Gauges, electrum, for pluviometers	200	487	8
Handles, brass, for chains	32	16	0
Iron bolts and nuts	16	16	0
May's rapid traversing instrument	1	250	0
Photographic printing frames	2	118	0
Carried over	294	1,037	0

MATHEMATICAL INSTRUMENT OFFICE.

TABLE C.

Instruments, etc., manufactured in the Mathematical Instrument Office during 1895-96—contd.

Specification.	Number.	Value. R	a.
Sundries—contd.			
Brought forward	294	1,037	0
Rain-gauge to hold 25 inches of rain	1	18	0
Rods, ranging, 4 feet	12	18	0
Scales, brass, 6-inches = 1 mile	12	120	0
" metal, 16-inches = 1 mile	255	255	0
Screws of sorts and sizes	200	20	0
Snow gauges, with foot	12	96	0
Subtense vane, block tin	12	12	0
Tin tubes	5	2	8
Zinc tickets	900	33	12
Scales, letter-weighing	1	22	0
TOTAL	1,704	1,634	4
ADD TOTAL OF INSTRUMENTS	24,075	28,178	14
SUM TOTAL	25,779	29,813	2

MATHEMATICAL INSTRUMENT OFFICE.

TABLE D.

List of principal instruments repaired in Workshop during 1895-96.

Specification.	Number.
Anemometers	22
Arithmometers	5
Barometers of sorts	122
Boards, drawing	2
Camera	2
Cards for compasses	22
Cases, sketching, leather	2
Chains of sorts	115
Chronographs	12
Chronometers of sorts	3
Chrono-micrometers	5
Clinometers of sorts	103
Clocks	10
Compasses, beam	2
" bowpens	135
" " pencils	4
" with pens and pencils	13
" bow dividers, spring	12
" drawing, common, of sorts	237
" " hair, of sorts	4
" magnetic pocket	5
" rectangular, of sorts	112
" marine	1
" prismatic, of sorts	134
" proportional, of sorts	4
" surveying, of sorts	11
Curves, French	2
Declinometers	2
Dials, miners	2
Dip circle	1
Eidographs	1
Glasses, binocular, of sorts	91
Heliographs	21
Heliotropes	5
Horizon, artificial	7
Hydrometers	58
Hygrometers of sorts	6
Instruments, drawing, mathematical, of sorts	53
" time of flight	2
Lamps of sorts	5
Levels of "	180
Lenses of "	3
Magnets of sorts	23
Magnetometers	1
Mekometers	4
Micrometers	3
Microscopes	2
Metre current	2
Passometer	1
Pens, drawing, of sorts	234
" dotting	4
Pentagraphs	5
Pins of sorts	73
Plane-tables	53
Planimeters	26
Pointers, station	6
Protractors	3
Quintants, sounding	10
Rain-gauges	5
Carried over	1,993

MATHEMATICAL INSTRUMENT OFFICE.

TABLE D.

List of principal instruments repaired in Workshop during 1895-96—contd.

SPECIFICATION.	Number.
Brought forward	1,993
Rules of sorts	167
" sight, of sorts	5
Scales of sorts	23
Scott's sights, B. L. telescopic	119
Set squares	4
Sextants of sorts	7
Squares, optical	211
Stands for compasses	70
Range-finders	20
Stands for galvanometers	1
" for heliographs	2
Stands for levels	89
" for miners dial	2
" for plane-tables	55
" for theodolites	39
Staves, levelling, of sorts	101
Stencil plates	17
T. squares	2
Tacheometer	1
Tapes of sorts	517
Telescopes of sorts	127
Telemeters	7
Theodolites of sorts	95
Thermometers of sorts	72
Transit instruments	1
Timepieces	4
Type writers	19
Vanes, sight	3
" wind	2
Watches of sorts	29
TOTAL OF PRINCIPAL INSTRUMENTS REPAIRED	3,804
" " MINOR INSTRUMENTS REPAIRED	1,004
TOTAL OF ALL INSTRUMENTS REPAIRED	4,808

MATHEMATICAL INSTRUMENT OFFICE.

Profit and Loss Account of the Workshop for the financial year 1895-96.

Debits.	R a.	Credits.	R a.	R a.
To Workshop Establishment (less proportion debitable to the Store Branch for cleaning and adjusting serviceable instruments) .	33,293 14	By repairs for public officers on book debit	13,293 5	
" One third of Office Establishment . . .	2,535 14	" repairs for public officers on payment .	8,796 15	22,090 4
" Pay of material Store-keeper for the whole year . .	780 0	" repairs for stock . .		29,875 12
" Workshop contingencies as distinguished from material purchased . .	2,212 14	" manufacture for stock— Instruments . .		28,040 6
" Value of materials :— For ordinary work . " general workshop use " manufacture of packing cases . .	26,913 5	Packing cases . .		1,624 5
		" manufacture of materials		3,252 0
" Paid for repairs . .	254 8			
" Wear and tear of plant .	1,431 3			
" Half of rent @ R600 per mensem . . .	3,600 0			
" Printing and stationery .	355 0			
" Four per cent. on value of tools and plant amounting to R1,18,896-2 . .	4,755 13			
" Half of taxes, rates, etc. .	877 0			
" Liability for pensions .	3,948 0			
" Profit	3,925 4			
Total .	84,882 11	Total .		84,882 11

TRIGONOMETRICAL BRANCH OFFICE, DEHRA DUN.

Narrative Report of MR. J. ECCLES, M.A., *Deputy Superintendent, 1st grade, in charge Computing Party, Season 1895-96.*

The alterations to the Office buildings mentioned in last report have been finished, and the accommodation is now sufficient for our present wants.

The Hand-Book of Instructions for the Topographical Branch having run out of print, a second edition was taken in hand and the book is now about to be published with the matter brought into close accordance with the later orders and methods of survey.

The experiments to test the change in value of micrometer screws were continued. They were not very satisfactory, as the quantity to be observed is very small, but the result agreed very closely with what was to be expected from theory, and showed that there was some other cause at work besides the simple matter of temperature. The experiments will be continued.

A complete set of magnetic observations were taken, and as it is intended to continue the observations at stated intervals a small pamphlet has been compiled for the use of observers.

The cost of the Computing Section under its various class heads and the percentages thereof, together with those of the three preceding years, are given in the following statement:—

CLASS.	COST IN RUPEES.	PERCENTAGE OF COST.			
	1895-96.	1895-96.	1894-95.	1893-94.	1892-93.
1. Records, Library	873	2·9	3·4	1·4	2·6
2. Accounts, Returns, Correspondence	1,551	5·2	8·1	7·1	5·4
3. Supply of data, etc.	514	1·7	2·7	3·0	2·3
4. Computations	2,857				
5. Preparation of Press copy	8,856	78·5	75·8	78·6	79·5
6. Examination of Press proofs	11,940				
7. Ditto of charts	882	2·9	1·4	0·6	1·5
8. Protection of stations	592	3·3	2·2	1·2	1·2
9. Miscellaneous	1,328	4·4	4·3	6·2	6·2
10. Meteorology, etc.	342	1·1	1·9	1·3	1·1
11. Extra-departmental work	...	...	0·2	0·6	0·2
	30,135	100	100	100	100

From the above table it will be seen that the working power of this section has been distributed much in the same way as in preceding years, excepting classes 7 and 8, which show an increase due to some special and extra work that had to be done.

The following is an account of the work done under the several classes shown in the foregoing table:—

CLASS I.—RECORDS, LIBRARY, etc.—Five fresh instalments of field records were received during the year; these, together with the records already stored in the office, have received the usual care and attention. The three standard copies of the library catalogue have been kept up to date. The library books which were lying stored in boxes as reported last year were taken out, re-arranged and put up in shelves.

CLASS 2.—ACCOUNTS, RETURNS AND CORRESPONDENCE.—In this is included the preparation of indents, estimates, monthly detailed and abstract progress reports, annual reports, stock returns of office stores, and various other items.

CLASS 3.—SUPPLY OF DATA.—Twenty requisitions for data and 14 indents for forms were received and complied with during the year; in all sixteen thousand copies of various forms were supplied.

CLASS 4.—COMPUTATIONS.—The following are the details:—

North-East Longitudinal Series. Secondary work.—Selection and computation of triangles to snowy peaks proceeded with, but unfortunately not much progress was made owing to the amount of other computations which was required.

Spirit-levelled Heights, Nos. 7 and 8 (Revised Edition) and No. 9.—Adjustment to mean sea-level completed.

Indus Delta Secondary Triangulation.—Angle books examined and final reduction of observations and computations completed, excepting the heights.

Electro-Telegraphic Longitudes.—Help afforded in the reduction of observations for 1894-95; a pair of computers was engaged for about a month and a half in this work.

Chitral Triangulation.—Reduction of observations completed.

Azimuth observations of No. 24 (Upper Burma) Party.—Reduction of observations at one station partly checked.

Experimental computations in connection with reduction of Figures by seven and ten place logarithmic tables made, the result being that whenever logarithms to eight places are used, they should be deduced from ten-place logarithmic tables, otherwise there is a liability to error both in sides and angles.

CLASS 5.—PREPARATION OF PRESS COPY.—This entails abstracting and compiling the final results of the various calculations in a suitable form for publication; all such compilations are twice compared, once against the original field records, and once against the final calculations, prior to being sent to the press.

The details of the work done are as follows:—

(*a*) *Southern Trigon.*—Much progress has been made with the preparation of the co-ordinate list for the synoptical volume of the Great Arc Meridional Series, Section 8° to 18°; it may be considered almost completed. There remains only the final revision which will be done as the work is being passed through the press.

(*b*) *Indus Delta Secondary Triangulation.*—Triangles and azimuth list completed; co-ordinate list partly done.

(*c*) *The Pamphlets of spirit-levelled Heights, Nos. 7 and 8 (Revised Edition) and No. 9 of Heights in Calcutta.*—Completed.

(*d*) *Instructions for taking magnetic observations.*—Completed.

(*e*) *Hand-book of Professional Instructions for the Topographical Branch, second edition.*—Completed and 126 pages examined.

CLASS 6.—EXAMINATION OF PRESS PROOFS.—This requires the utmost care in comparison and examination in the several stages of first, second and form proofs. Most of the matter printed is numerical, or depending on numerical data; hence it necessarily involves a strictly critical examination, which can only be given by men specially trained to this style of work.

The printing of the following works has been completed during the year:—

(1) Spirit-levelled Heights, No. 8 C. P. and Orissa (Revised edition).
(2) Spirit-levelled Heights, No. 9 Orissa and N. Circars.
(3) Spirit-levelled Heights in Calcutta.
(4) Instructions for taking magnetic observations.

Nos. (1), (2) and (3) were bound, examined and issued to the several recipients.

The printing of the Tidal Volume is being slowly proceeded with and that of the Hand-book of Professional Instructions for the Topographical Branch (second edition) is nearly completed; the latter will be ready for issue in another two months.

CLASS 7.—EXAMINATION OF CHARTS.—Comparison and examination of two preliminary charts of Monghsat Secondary Series completed.

Comparison of the preliminary chart of the lower portion of Singi Meridional Series completed.

Comparison and examination of two preliminary charts of Eastern Frontier Series, seasons 1874-75 and 1875-76, completed.

Preparation and examination of data for three other charts completed.

CLASS 8.—PROTECTION OF STATIONS.—The usual professional work in connection with the protection of survey stations and certain of the bench-marks in the North-Western Provinces and 24-Pergunnahs was performed. During the year 642 stations have been repaired by the District Officers at a cost of R2,410-15-10; twenty-four districts out of 347 from which reports are due failed to submit them. In March and April 1896, the two stations marking the ends of the Dehra Dun Base-line were visited and inspected by Mr. H. W. Peychers of this department: one was put into thorough repair, and the other was almost entirely rebuilt.

CLASS 9.—MISCELLANEOUS.—In this are included various duties which cannot be fairly assigned to any of the other classes, such as the following:—

(*a*) The Examination and despatch of printed papers to the Survey of India Office, Calcutta, for safe custody.
(*b*) The Examination of all bound volumes and pamphlets prior to issue, and the preparation of the distribution lists and presentation labels for the same.
(*c*) The preparation of examination papers for the Provincial Service of the Survey of India Department, of which 34 sets were prepared and examined, and the results tabulated and submitted to the Surveyor-General.

CLASS 10—METEOROLOGY AND GENERAL SCIENCE.—As hitherto, a complete set of meteorological observations was taken daily throughout the year and monthly and annual

abstracts prepared. The meteorological results are given in the following tabular statements :—

Mean Monthly Readings of Earth Thermometers.

Depth in feet of thermometer bulbs below surface of ground.	Year.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.
25·6	1895-96	76·33	76·36	76·22	75·99	75·53	74·94	74·39	74·19	74·24	74·57	76·20	77·20
	Mean 1881—95	76·80	76·85	76·65	76·03	75·49	74·87	74·30	74·02	73·98	74·31	75·52	76·50
12·8	1895-96	79·23	78·17	76·67	74·50	72·72	71·56	71·95	73·89	75·95	78·16	80·11	80·57
	Mean 1881—95	79·40	78·02	75·73	73·13	71·43	70·62	71·24	73·03	75·14	77·13	79·06	79·63
6·4	1895-96	79·97	76·61	72·61	68·83	66·92	68·20	72·78	78·12	81·37	82·36	82·48	82·25
	Mean 1881—95	79·65	75·69	71·05	67·13	65·40	67·01	71·43	76·66	80·13	81·24	81·35	81·15
3·2	1895-96	78·45	73·25	66·47	63·41	62·13	68·48	77·91	84·19	85·66	84·60	82·73	83·78
	Mean 1881—95	78·10	71·53	65·44	61·78	61·18	66·57	75·25	81·81	84·60	83·27	82·01	81·55
1·1	1895-96	76·48	70·68	61·11	59·20	60·16	70·24	81·85	89·29	87·79	86·09	82·73	83·37
	Mean 1881—95	76·03	67·26	60·02	57·15	58·45	67·43	78·50	85·62	87·73	84·02	82·31	81·53
Thermometer in shade.	1895-96	80·18	74·90	67·81	66·81	67·46	81·48	92·73	96·21	87·36	85·31	81·65	85·61
	Mean 1881—95	80·40	73·26	67·75	63·89	66·87	78·43	89·61	93·64	90·09	82·29	80·61	82·34

Mean velocity in miles of the Winds which blew at Dehra Dun during the twelve months of 1895-96 for each hour of the day.

Civil Hours.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	Mean.
0 to 1	1·16	1·37	0·43	0·45	0·55	0·58	1·33	0·87	0·50	0·73	0·90	1·30	0·85
1 „ 2	0·94	0·83	0·23	0·59	0·72	0·52	1·13	0·74	0·50	0·53	1·10	1·20	0·75
2 „ 3	0·71	0·80	0·00	0·34	0·72	0·42	1·03	0·45	0·17	1·00	0·87	0·90	0·62
3 „ 4	0·55	0·57	0·07	0·24	0·55	0·52	0·90	0·19	0·37	0·60	0·65	0·83	0·50
4 „ 5	0·45	0·37	0·03	0·14	0·34	0·45	0·73	0·39	0·53	0·87	0·81	0·67	0·48
5 „ 6	0·29	0·33	0·00	0·24	0·17	0·26	0·43	0·19	0·53	0·57	0·68	0·40	0·34
6 „ 7	0·13	0·23	0·00	0·21	0·17	0·13	0·57	0·10	0·57	0·33	0·52	0·57	0·29
7 „ 8	0·03	0·07	0·03	0·17	0·14	0·26	0·67	0·55	0·90	0·53	0·52	0·77	0·39
8 „ 9	0·13	0·07	0·00	0·03	0·17	0·35	1·03	1·23	0·60	1·07	0·94	1·27	0·57
9 „ 10	0·32	0·07	0·00	0·10	0·41	0·77	1·57	2·16	1·47	1·60	1·68	1·67	0·99
10 „ 11	0·81	0·67	0·26	0·28	0·97	1·16	2·63	1·97	1·60	1·90	1·97	1·60	1·32
11 „ 12	1·29	1·23	0·74	0·66	0·72	1·61	3·10	2·42	1·53	1·87	2·06	1·90	1·59
12 „ 13	1·45	2·20	0·70	0·86	1·38	2·48	3·30	2·74	2·17	1·93	1·84	2·00	1·92
13 „ 14	1·84	2·53	0·90	1·21	1·62	2·65	4·80	3·10	2·17	1·79	2·48	1·70	2·23
14 „ 15	1·94	2·20	1·00	1·07	1·45	3·26	5·03	3·55	2·27	1·69	1·90	2·17	2·29
15 „ 16	1·35	1·70	0·93	1·17	1·97	3·39	4·83	3·06	2·00	1·59	2·06	1·73	2·15
16 „ 17	0·58	0·47	0·50	0·86	1·69	3·32	5·10	2·84	1·93	1·13	1·68	1·13	1·77
17 „ 18	0·06	0·07	0·07	0·45	0·83	2·26	3·53	2·29	1·70	0·90	0·94	0·37	1·12
18 „ 19	0·84	0·27	0·03	0·34	0·31	0·87	1·83	1·19	1·13	0·63	0·42	0·53	0·70
19 „ 20	1·42	0·63	0·17	0·14	0·28	0·35	0·47	0·71	0·57	0·50	0·52	0·90	0·56
20 „ 21	1·32	1·30	0·23	0·31	0·31	0·77	0·57	1·06	0·33	0·43	0·48	1·13	0·69
21 „ 22	1·68	1·67	0·30	0·48	0·48	1·13	0·90	1·29	0·60	0·37	0·52	1·53	0·91
22 „ 23	1·58	0·63	1·47	0·38	0·34	1·00	1·00	0·81	0·53	0·50	0·58	1·70	0·88
23 „ 24	1·77	0·67	1·43	0·38	0·34	0·71	1·43	0·68	0·90	0·63	0·61	1·53	0·92
Sums	22·64	22·95	7·52	11·10	16·63	29·22	47·91	34·58	25·57	23·69	26·73	29·50	...
Average	0·94	0·96	0·31	0·46	0·69	1·22	2·00	1·44	1·07	0·99	1·11	1·23	...

Monthly Meteorological Results of Observations taken at the Office of the Trigonometrical Branch, Survey of India, Dehra Dun.

Year and Month.	Barometer reduced to 32° Fah.						Hygrometer.		Thermometer.				Rain.		Wind.	Cloud.	
	At 10 A.M.			At 4 P.M.			10 A.M.	4 P.M.	Dry Bulb.			Wet Bulb.					
	Highest.	Lowest.	Monthly mean.	Highest.	Lowest.	Monthly mean.	Monthly mean humidity.	Monthly mean humidity.	Highest maximum in air.	Lowest minimum in air.	Monthly mean in air.	Lowest minimum.	Number of days it fell.	Fall in inches.	Most frequent direction.	At 10 A.M.	At 4 P.M.
1895.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	°	°	°	°	°	°					
October	27·825	27·461	27·699	27·754	27·399	27·613	49	42	88·0	51·5	68·8	47·6	1	0·18	Calm.	1·0	0·5
November	·929	·719	·819	·858	·591	·722	51	48	83·7	48·6	64·0	45·8	1	0·14	"	1·7	2·5
December	·928	·692	·832	·838	·596	·741	46	38	75·1	40·6	55·3	36·7	0	*Nil.*	"	1·7	2·7
1896.																	
January	·937	·655	·808	·853	·586	·710	51	39	76·7	38·1	55·1	36·7	3	1·21	Calm.	3·7	3·5
February	·900	·586	·747	·806	·534	·657	55	42	78·7	40·4	57·3	37·4	4	1·11	"	4·3	6·1
March	·768	·543	·663	·651	·450	·563	36	22	94·7	48·0	68·6	43·2	1	0·26	W.	4·0	5·0
April	·701	·327	·563	·604	·291	·452	21	10	102·5	53·7	79·7	42·2	0	0·01	W.	2·0	2·9
May	·641	·417	·509	·584	·286	·403	29	23	105·9	64·9	85·4	52·8	3	0·90	S. W. & W.	2·4	3·6
June	·579	·173	·415	·507	·142	·319	67	62	98·3	64·4	81·6	63·5	13	17·47	S. E.	4·5	6·4
July	·502	·227	·380	·424	·139	·296	80	72	94·0	70·9	80·1	68·7	16	13·78	S. E.	6·5	6·0
August	·568	·284	·459	·519	·258	·382	84	81	89·0	67·8	77·2	66·5	20	37·92	N. & S. E.	7·5	7·8
September	·762	·414	·556	·658	·345	·462	64	58	89·3	62·7	77·0	56·7	2	1·72	S. S. E.	1·4	2·5

TYPE-PRINTING SECTION.—As will be seen from the annexed statement, the greater part of the work done consisted in printing forms, professional and others, for the Department, and in setting up the large number of small headings, foot-notes, etc., required in the Drawing Section in connection with the publication of maps.

Statement of work done during 1895-96.

SPECIFICATION OF PRINT.	No. of pages.	Total No. of pulls.	No. of copies of each page.	VALUE.
				R
Professional volume	36	5,310	500	1,116
Synoptical volume	24	2,550	350	728
Topographical Hand-Book (second edition)	180	20,680	400	3,629
Pamphlets of Spirit-levelled heights	141	9,680	300 & 350	2,945
Letter-press for charts, map headings, foot-notes	247	4,800	...	1,886
Forms	285	90,210	...	4,761
Miscellaneous	161	33,401	...	2,215
Extra-departmental work	125	1,000	...	149
	1,199*	167,631	...	17,429

* Equal to 1,135 pages of standard (foolscap) size.

The usual table showing the work annually performed by this section during the past five years is given below, the unit (a page of foolscap) being the same throughout :—

	1891-92.	1892-93.	1893-94.	1894-95.	1895-96.
Pages composed	2,228	2,195	1,638	1,219	1,135

An analysis of the pages composed in 1895-96 is as follows :—

PROFESSIONAL VOLUME	Tidal Volume	72
SYNOPTICAL VOLUME	Great Arc Meridional Series	36
MISCELLANEOUS	Spirit-levelled heights	141
	Letter-press for charts, map, headings, foot-notes	175
	Forms, orders, memoranda, etc.	390
	Miscellaneous	91
	Extra-departmental work	50
	Topographical Hand-Book	180
	TOTAL.	1,135

PHOTO-ZINCOGRAPHIC SECTION.—As several demands were made during the year for cheap prints from tracings, experiments were made with the process given by Colonel Waterhouse in last year's report. The formula given there had to be slightly modified and good results are now obtained as follows :—

A solution is made up of—

Distilled water	16 oz.
Citrate of iron and ammonia	2½ oz.
Nitrate of silver	¾ oz.
Tartaric acid	1¼ oz.

This is filtered. Bank post paper is coated evenly with the filtered solution either with a brush or sponge and exposed behind the trace for 2 minutes to 2½ minutes in a winter sun (the exposure would probably be under 1 minute in strong sunlight). The paper is washed well in water, fixed with a 10 per cent. solution of hyposulphite of soda, again well washed and dried at the fire. The result is a paper negative of a dense chocolate brown colour. For the prints the same process is adopted, only that double elephant glazed paper is used instead of bank post and that the exposure is about 5 minutes in a weak light.

The cost is about six annas for a standard sheet.

The following tables exhibit the value and outturn of work done by this section :—

Abstract of departmental work done during the year 1895-96.

Specification.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic Printing.						Silver and other Printing.		Value.	
			Photo-transfer prints.	Zinc plates.	Pulls.	Number of copies.			Silver prints.	Blue and other prints.		
						Coloured.	Uncoloured.	Total.			R	a.
Standard maps	212	428	599	219	21,787	...	19,026	19,026	...	24	12,949	8
Index maps	16	4	32	4	150	...	174	174	...	...	218	6
Technical charts	15	34	47	13	1,490	...	2,005	2,005	...	...	915	10
Miscellaneous maps and plans	217	108	56	24	2,820	...	4,244	4,244	48	58	2,072	15
Transfers and proofs	...	...	...	...	2,226	...	...	...	...	...	......	
Departmental forms	3	2	8	3	375	...	775	775	...	...	131	14
Totals	463	576	742	263	28,848	...	26,224	26,224	48	82	16,288	5

Statement of work done for other departments, etc., during the year 1895-96.

Departments, etc.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic Printing.						Silver and other Printing.		Value.	
			Photo-transfer prints.	Zinc plates.	Pulls.	Number of copies.			Silver prints.	Blue and other prints.		
						Coloured.	Uncoloured.	Total.			R	a.
Forest survey	134	230	215	117	10,727	...	11,001	18,001	...	12	5,822	13
Private individuals	2	...	...	...	40	...	40	40	...	...	11	8
Totals	136	230	215	127	10,767	...	11,041	11,041	...	12	5,834	5

Table showing the amount realized from other departments, etc, by book debit and cash sales during 1895-96.

Departments, etc.	By book debit.		By cash sales.		Total.	
	R	a.	R	a.	R	a.
Forest Department	80	2	176	3	256	5
Forest Survey	5,611	0	292	7	5,903	7
Quarter Master General	479	6	224	0	703	6
Military Department	......		222	13	222	13
Other Departments	......		269	3	269	3
Private individuals	......		281	10	281	10
Totals	6,170	8	1,466	4	7,636	12

CORRESPONDENCE SECTION.—The work in this section has been carried on as usual.

STORES, WORKSHOPS, AND OBSERVATORIES SECTION.—The extra work, in connection with the reconstruction of the office, thrown on the workshops, was finished. In the observatories the usual time observations were taken, the chronometers rated and kept in order, and other miscellaneous works done, including the experiments for variation of the values of micrometer screws already mentioned.

SOLAR PHOTOGRAPHIC SECTION.—The details of the work of this section are given below:—

Table showing the number and character of the negatives.

1895-96.	Number of days.				Number of Negatives.										Number of working days when Solar Phenomena were	
	When negatives were taken.	Failures.			Solar Phenomena.								Total.			
		From bad weather.	From various causes.	Total.	Spots and faculæ.		Spots only.		Faculæ only.		None.					
					8″	12″	8″	12″	8″	12″	8″	12″	8″	12″	Visible.	Absent.
October . .	30	1	...	31	56	...	...	...	...	...	...	...	56	...	30	...
November .	28	2	...	30	48	...	...	...	3	...	...	...	51	...	28	...
December . .	30	1	...	31	52	...	...	...	...	...	...	...	52	...	30	...
January . .	27	4	...	31	49	...	...	...	...	...	...	...	49	...	27	...
February . .	22	7	...	29	40	...	...	...	...	...	...	...	40	...	22	...
March . .	29	2	...	31	52	...	...	...	...	...	...	...	52	...	29	...
April . .	30	...	...	30	44	...	...	...	10	...	...	...	54	...	30	...
May . .	30	1	...	31	51	...	...	...	3	...	...	...	54	...	30	...
June . .	26	4	...	30	46	...	...	...	...	...	...	...	46	...	26	...
July . .	25	6	...	31	42	...	...	...	...	...	...	...	42	...	25	...
August . .	17	13	1	31	21	...	...	...	4	...	...	...	25	...	17	...
September . .	30	...	...	30	54	...	...	...	...	...	...	...	54	...	30	...
TOTAL .	324	41	1	366	555	...	...	...	20	...	...	...	575	...	324	...

Seven hundred and sixty-five silver prints of the 8-inch pictures were prepared, and weekly despatches of both silver prints and negatives made as usual to the India Office.

Table showing the visibility of Sun at Dehra Dun and Greenwich.

Year.	At Dehra Dun.			At Greenwich.		Remarks.
	Number of days on which negatives were taken.	Percentage of days on which negatives showed features.	Number of days on which sun was invisible.	Year.	Number of days on which negatives were taken.	
1880-81*	307	96	55	1880	156	* From 1st October to 30th September following.
1881-82	328	100	37	1881	181	
1882-83	318	100	47	1882	221	
1883-84	285	100	78	1883	215	
1884-85	284	100	81	1884	154	
1885-86	290	100	75	1885	206	
1886-87	302	98	61	1886	199	
1887-88	328	91	38	1887	188	
1888-89	315	71	50	1887-88	205	
1889-90	320	78	45	1888-89	182	
1890-91	303	99	62	1889-90	212	
1891-92	304	100	62	1890-91	224	
1892-93	292	100	73	1891-92	219	
1893-94	304	100	61	1892-93	220	
1894-95	313	100	52	1893-94†	230	† Year ending 10th May 1894, obtained from the report to the Board o Visitors.
1895-96	324	100	41	1894-95	Not obtainable.	
Mean	307	...	57	...	201	

DRAWING SECTION.—The details of the work done in this section are given in the tables which follow :—

Statement showing the work performed during 1895-96.

TITLE OF MAP.	Number of sheets.	Scale.	REMARKS.
Standard Maps.		In. M.	
Hazara and Isazai Expeditions, 1891-92, sheets Nos. 1, 2 and 3	3	1=¼	Corrections completed and final press order given.
Punjab Survey, sheet No. 265 N. E.	4	1=½	Corrections completed for reduction to ½ scale. Final press order given.
Sheets Nos. 264 S. E., 265 S. E., 285 S. E., 285 S. W., 286 N. W. and 246 N. E.	24	1=½	Corrections for reduction to ½ scale. In hand.
Gujarat Survey, sheet No. 29	4	1=1	Corrections completed for 2nd edition. Final press order given.
Level sheets Nos. 67, 74 and 88	3	1=2	Compilation in hand.
Dehra Dun and Siwaliks, sheets Nos. 7, 8, 16, 24 and 25	5	1=¼	Corrections to tea gardens completed. Final press order given.
Dehra Dun and Siwaliks, sheets Nos. 1, 2 and 3	3	1=1	Corrections for 2nd edition in hand.
Plans of Cities and Cantonments.			
Dehra Dun Municipality and Cantonment (2nd Edition)	3	1=¼	Corrections completed. In hand.
Index Maps.			
Triangulation Chart of India	1	1=96	Brought up to date for Annual Report.
To illustrate progress of Nos. 14 and 18 Parties	2	Various	Ditto ditto.
Index to the Forest Surveys in Districts Bilaspur and Sambalpur	2	Various	Completed headings and foot-notes. Final press order given.
Charts.			
Triangulation Chart of Great Arc Series, Sections 8° to 18°	4	1=4	In hand.
Specimen Chart for circulation	1	1=4	Completed and final press order given.
Eastern Frontier Series Preliminary Charts for seasons 1876-77 and 1877, 1878 and 1879-80	2	1=4	Corrections completed. Final press order given.
Nos. 43 and 44, Preliminary Charts of Indus Delta Coast Triangulation	2	1=4	In hand.
Miscellaneous.			
Tidal maps of Port Albert Victor, Negapatam and Trincomallee	3	Various	Completed. Final press order given.
Tidal maps of Tuticorin, Galle, Madras, False Point, Amherst, Colombo, Minicoy, Rangoon, Pamban Pass, Bombay, Dublat, and Diamond Harbour	12	Various	In hand.
Chart No. 1 showing Arcs of Longitude, connecting England and India	1	...	Prepared in colours to accompany Annual Report. Final press order given.
Chart No. 2 illustrating connection in Longitude between Greenwich and Madras	1	...	
Other maps	37	Various	Touched up for photography, and completed as regards headings, foot-notes and references for press.
Maps coloured	2,236	Various	

Statement showing the work performed during 1895-96—contd.

MAPS EXAMINED.

	No. of Sheets.
Standard original maps	91
Charts	3
Miscellaneous maps	43
Photographic proofs of standard sheets and other maps	234
TOTAL .	371

N.B.—In addition to the above, other miscellaneous duties have been performed, such as completing Central Provinces and Punjab Survey sheets, Spirit-levelling Operation sheets, etc., in respect of headings, foot-notes, symbols, etc., for press; supplying traces to No. 10 Party; surveying Body Guard Cantonment on scale of 1" = 30 feet; tracing Delhi-Kalka-Umballa Railway line map, and of Mohan Pass, between Dehra Dun and Saharanpur; taking out and checking areas of villages, their cultivation, forests, etc., of 22 Punjab Survey sheets; examination and custody of records; making all the despatches of maps; etc., etc., etc.

Statement of work done for other Departments during 1895-96.

TITLE OF MAP.	Number of sheets.	Scale.	REMARKS.
		In. M.	
Standard Maps.			
Forest Surveys	92	1 = ¼	Completed headings, foot-notes and references. Final press order given for Forest Department.
Index Maps.			
Forest Surveys	1	1 = 5	Ditto ditto ditto.
Charts.			
Forest Surveys	2	1 = 1	Ditto ditto ditto.
Miscellaneous.			
Forest Surveys	19	Various	Ditto ditto ditto.

List of Maps published for the Forest Survey Branch during 1895-96.

Title of Maps.	Scale.	Number of sheets.
STANDARD MAPS.	In. M.	
BURMA.		
Pyinmana Forest Survey.		
Sheets Nos. 270 $\frac{\text{S. W.}}{1}$ and $\frac{\text{S. W.}}{2}$	4=1	2
CENTRAL PROVINCES.		
Bhandara Forest Survey.		
Sheets Nos. 93 $\frac{\text{N. W.}}{1}$, $\frac{\text{N. W.}}{3}$, $\frac{\text{N. E.}}{1}$, $\frac{\text{N. E.}}{3}$ (part of), and $\frac{\text{S. E.}}{4}$; 94 $\frac{\text{N. E.}}{1}$, $\frac{\text{N. E.}}{2}$, $\frac{\text{N. E.}}{3}$, $\frac{\text{N. E.}}{4}$, $\frac{\text{S. W.}}{2 \& 4}$, and $\frac{\text{S. E.}}{2}$; 95 $\frac{\text{N. E.}}{2}$, $\frac{\text{N. E.}}{3}$, $\frac{\text{N. E.}}{4}$, $\frac{\text{S. W.}}{1 \& 2}$, $\frac{\text{S. W.}}{4}$, and $\frac{\text{S. W.}}{3}$ (part of); 96 $\frac{\text{N. W.}}{2}$, and $\frac{\text{N. W.}}{1}$ (part of), $\frac{\text{N. W.}}{4}$, and $\frac{\text{N. E.}}{1 \& 2}$; 115 $\frac{\text{N. W.}}{3}$, $\frac{\text{S. W.}}{1}$, $\frac{\text{S. W.}}{3}$, and $\frac{\text{S. W.}}{4}$; 116 $\frac{\text{N. W.}}{1}$, $\frac{\text{N. W.}}{2}$, $\frac{\text{N. W.}}{4}$, $\frac{\text{S. W.}}{2}$, $\frac{\text{S. W.}}{3}$, and $\frac{\text{S. W.}}{4}$	4=1	28
Balaghat Forest Survey.		
Sheets Nos. 91 $\frac{\text{N. E.}}{2}$, 91 $\frac{\text{S. E.}}{1}$, and $\frac{\text{N. E.}}{3}$ (parts of) and $\frac{\text{S. E.}}{4}$; 92 $\frac{\text{N. W.}}{2 \& 4}$, and $\frac{\text{N. E.}}{1}$ (parts of); and 113 $\frac{\text{S. W.}}{1}$	4=1	5
Narsinghpur Forest Survey.		
Sheets Nos. 50 $\frac{\text{N. E.}}{2 \& 4}$; 67 $\frac{\text{S. W.}}{2 \& 4}$; 68 $\frac{\text{N. E.}}{1}$, $\frac{\text{N. E.}}{3}$, and $\frac{\text{S. E.}}{1}$; 87 $\frac{\text{S. W.}}{3}$; and 88 $\frac{\text{N. W.}}{1}$	4=1	6
Nagpur-Wardha Forest Survey.		
Sheets Nos. 73 $\frac{\text{N. W.}}{2}$ and $\frac{\text{N. E.}}{3}$	4=1	2
Raipur Forest Survey.		
Sheets Nos. 165 $\frac{\text{N. E.}}{4}$ and $\frac{\text{S. E.}}{2 \& 4}$; 187 $\frac{\text{S. E.}}{2}$, $\frac{\text{S. E.}}{4}$; 188 $\frac{\text{N. E.}}{1}$, $\frac{\text{N. E.}}{2}$; 189 $\frac{\text{N. E.}}{1 \& 3}$, $\frac{\text{S. E.}}{2}$; 208 $\frac{\text{S. W.}}{1}$, $\frac{\text{S. W.}}{3}$; 209 $\frac{\text{N. W.}}{1}$, $\frac{\text{N. W.}}{3 \& 4}$, $\frac{\text{S. W.}}{1}$, $\frac{\text{S. W.}}{2}$, $\frac{\text{S. W.}}{3}$, $\frac{\text{S. W.}}{4}$; and 210 $\frac{\text{S. W.}}{3}$	4=1	17
NORTH-WESTERN PROVINCES AND OUDH.		
Kheri Forest Survey.		
Sheets Nos. 99 $\frac{\text{N. E.}}{1}$ and $\frac{\text{N. E.}}{2}$ (part of); 99 $\frac{\text{N. E.}}{4}$ and 114 $\frac{\text{N. W.}}{3}$ (part of); 99 $\frac{\text{S. E.}}{2}$ and 114 $\frac{\text{S. W.}}{1}$ (part of); 99 $\frac{\text{S. E.}}{4}$ and $\frac{\text{S. E.}}{3}$ (part of)); 100 $\frac{\text{N. E.}}{2}$; 113 $\frac{\text{S. W.}}{3}$ and $\frac{\text{N. W.}}{1}$; 114 $\frac{\text{N. W.}}{4}$, $\frac{\text{S. W.}}{3}$, $\frac{\text{S. E.}}{2}$; 115 $\frac{\text{N. W.}}{1}$, $\frac{\text{N. W.}}{3}$ and $\frac{\text{S. W.}}{1}$	4=1	11
Lalitpur Forest Survey.		
Sheets Nos. 43 $\frac{\text{N. E.}}{3}$; 44 $\frac{\text{N. E.}}{1}$, $\frac{\text{N. E.}}{2}$, $\frac{\text{S. E.}}{2}$; 59 $\frac{\text{N. W.}}{3}$; 60 $\frac{\text{S. W.}}{3 \& 4}$ and 61 $\frac{\text{N. W.}}{1 \& 2}$; 62A $\frac{\text{N. W.}}{2}$, $\frac{\text{N. E.}}{1}$, $\frac{\text{N. E.}}{2}$, $\frac{\text{N. E.}}{3}$; 62 $\frac{\text{S. W.}}{1}$, $\frac{\text{S. W.}}{2}$ (parts of); $\frac{\text{S. E.}}{1}$, $\frac{\text{S. E.}}{3}$ and $\frac{\text{S. E.}}{4}$	4=1	15

List of Maps published for the Forest Survey Branch during 1895-96.

Title of Map.	Scale.	Number of sheets.
STANDARD MAPS—*contd.*		
PUNJAB.		
Bashahr Forest Survey.		
Sheets Nos. 331 $\frac{N. E.}{3}$ and $\frac{N. W.}{4}$, $\frac{S. E.}{1}$; 332 $\frac{N. E.}{2}$, $\frac{N. E.}{4}$; 333 $\frac{N. E.}{1}$	4=1	
Bashahr and Tiri Garhwal Forest Survey.		
Sheet No. 333 $\frac{N. E.}{4}$ (Punjab) or 226 $\frac{N. W.}{4}$ (N.-W. Provinces and Oudh) .	4=1	
" " 348 $\frac{N.W.}{3}$ (Punjab) or 226 $\frac{N. W.}{3}$ (N.-W. Provinces and Oudh) .	4=1	
Index Maps.		
Index of Allapilli working plan showing working circles and compartments . .	1=1	
CHARTS.		
Bashahr Forest Triangulation.		
Sheet No. 331	1=1	
" " 348	1=1	
Miscellaneous.		
Map of the Garhwal division showing classes of forests, etc.	1=4	
Map of the Darhwa taluk, Wun district, East Berar	1=1	
Map of the Ganges division showing classes of forests, etc.	1=4	
The Malkapur taluka, district Buldana, West Berar	1=1	
Saharanpur forest division	1=4	
Ranipur coppice working circle	2=1	
Tira " " "	2=1	
Budhaban " " "	4=1	
Kotri " " "	2=1	
Ranipur and Dholkand "	1=2	
Mohand and Barkala "	½=1	
Grazing working circle and plains mixed forest working circle	½=1	
Sál working circle	1=1	
Yeotmal taluk, Wun district, Hyderabad Assigned Districts	1=1	
Mangrul taluk, Basin districts, Berar	1=1	

G. I. C. P. O.—No. 14 S. G.—31-7-97.—450.

1897.

ile No. 123 of 1897.

erial No. 2.

GOVERNMENT OF INDIA.

DEPARTMENT OF REVENUE AND AGRICULTURE.

LAND-SURVEYS.

RESOLUTION.

No. 13—123-2.

Dated Simla, the 20th September 1897.

SUBJECT.

General Report on the operations of the Survey of India Department, during the year 1895-96.

G. C. Press, Simla,—No. 1079 R. & A. D.—21-9-97.—716.

Extract from the Proceedings of the Government of India in the Department of Revenue and Agriculture (Land-Surveys), No. 13—123-2, dated 20th September 1897.

READ—

The General Report on the operations of the Survey of India Department during the year 1895-96.

RESOLUTION.

The field operations of the Survey of India Department during the year ending 30th September 1896, were carried on by twenty-one parties (one of which was a double party) and two small detachments.

The various classes of work on which these parties and detachments were engaged were as follows:—

	No. of parties employed.	No. of detachments employed.
1. Trigonometrical	1	...
2. Topographical	6	...
3. Forests (excluding the Forest Survey Branch)	4	...
4. Cadastral	4	...
5. Traverse	3	2
6. Scientific	3	...
Total ...	21	2

Eleven parties and two detachments were thus employed on remunerative operations, that is to say on Forest and Cadastral Survey and Traverse work, as compared with eleven parties and one detachment similarly employed in 1894-95.

2. The aggregate area surveyed in detail during the year under review was 63,653 square miles against 1,25,381 square miles in the previous year, the decrease being almost entirely due to the smaller amount of geographical

reconnaissance that was undertaken, as will be seen from the following comparative statement:—

Class of work.	Area surveyed in square miles.	
	1894-95.	1895-96.
Topographical	21,588	19,798
Imperial Forest Surveys	2,612	3,202
Forest Survey Branch	1,616	1,712
Cadastral	6,934	8,609
Geographical	92,631	30,279
	125,381	63,600
Exceptional work not entered under special heads ...	3	53
TOTAL ...	125,384	63,653

3. As in the previous year, one party was employed on Trigonometrical operations and carried on the work of principal triangulation in Upper Burma and Baluchistan. The Mandalay Meridional series covered a direct distance of 18 miles, and an area of 360 square miles; and observations were extended into the valley of the Chindwin. In Baluchistan a beginning was made with the principal longitudinal series which, starting from the Great Indus series, is to be pushed westwards through Baluchistan. This series will afford a sound and accurate foundation for the work already executed in Baluchistan and Mekran and will, eventually, it is hoped, form the basis of a triangulation which will link up the trigonometrical systems of Asia and Europe.

4. Topographical operations were carried on in the Bombay Presidency, Sindh, Baluchistan, the Himalyas and Upper Burma. The 2-inch survey of the Southern Mahratta country, which has been in progress during the past nine seasons, was completed. The total area surveyed topographically was 19,798 square miles as compared with 21,588 in the year 1894-95.

5. The four parties of the Imperial Survey engaged on Forest Surveys were employed in the Central Provinces, the Bombay and Madras Presidencies and in Lower Burma. The Forest Survey Branch continued their operations in the Central Provinces, the North-Western Provinces and Oudh, the Chamba State and Upper and Lower Burma. The Himalaya party also surveyed an area of 200 square miles of forest in Kulu and Kangra and the Native States of Patiala and

Sirmur. The total outturn of forest survey work amounted to 4,914 square miles, of which 3,202 square miles were completed by Imperial parties and 1,712 square miles by the Forest Survey Branch, against 2,612 and 1,616 square miles respectively during the previous year. The cost rates in the Bombay and Madras Presidencies and in Lower Burma have generally been reduced; while in the Central Provinces they were somewhat higher than in the previous year.

6. Cadastral Survey operations by Imperial parties were carried on in Bihar by one double party, in Burma by two parties and in Assam by one party. Cadastral survey by local agency under the professional control of the Deputy Surveyor General, Revenue Branch, was also carried on in various districts of the North-Western Provinces and Oudh. The aggregate area surveyed in all Provinces amounted to 8,609 square miles, of which 3,269 square miles were executed by local agency in the North-Western Provinces and Oudh.

7. Traverse Survey operations were carried on by two parties in the North-Western Provinces and Oudh, by one party in the Central Provinces, and by two small detachments in Government Estates in Chota Nagpur, the total area traversed being 9,089 square miles.

8. From a scientific point of view, the most interesting and important feature of the year's work was the completion of the telegraphic determination of the difference of longitude between Greenwich and Karachi, which was begun last year by two parties working under Captains Burrard and Lenox-Conyngham. This determination is of the greatest importance, as providing a final datum for Indian longitudes. Arcs were measured from Karachi to Bushire, from Bushire to Teheran, from Teheran to Potsdam, and from Potsdam to Greenwich. Check arcs were also measured between Karachi and Jask, and Jask and Bushire. The final result was to increase the error which had already been suspected in the accepted longitude of Madras by 0·308 seconds, or about 150 yards linear. The work was carried through under considerable difficulties; a comparison between the Karachi-Bushire and Karachi-Jask-Bushire arcs shows that very high accuracy was attained; and the results reflect great credit upon the officers to whom they are due. In the course of their operations they received the most ready and valuable assistance from the German Government and its officials, from various officials in England, and from the officers of the Indo-European Telegraph Company, to all of whom the cordial acknowledgments of the Governor-General in Council are due.

9. Tidal observations with self-registering tide gauges were continued by one party at 13 stations in India, Burma, the Persian Gulf, Ceylon, the Andaman Islands and Minicoy; the series of observations at Minicoy and Trincomalee were terminated during the year; and a new tidal observatory was erected at Suez. Here again the acknowledgments of Government are due for much ready help rendered by officers not belonging to the Department. The line of double levels which is being run between Vizagapatam and Allahabad was continued over a length of 278 miles.

10. Geographical surveys and reconnaissances were carried on in Upper Burma and covered an area of 5,079 square miles of new country. The aggregate area geographically surveyed on the Eastern and Western Frontiers together, amounted to 30,279 square miles.

11. The progress of work at the Head Quarters Offices continued to be satisfactory. In the drawing section, good progress was made with the maps of Burma. The Provincial maps on the 16-mile scale and 66 sheets of the Atlas of India have been revised, and much miscellaneous work was in progress, while 4,900 cadastral sheets were issued during the year.

In the Engraving Section, good progress was made with the quarter sheets of the Atlas of India, and 18 district maps, a 16-inch map of Calcutta, the 128-mile map of India, a 16-mile map of Gujarat and the 80-mile Railway map of India were published. Progress was also made with new maps of Bengal, the Bombay and Madras Presidencies and the Punjab.

The Photo-Lithographic Section showed an increase of outturn, the value of the extra-departmental work amounting to Rs. 86,364 as compared with Rs. 76,534 in the previous year. The work maintained the high standard of excellence which it has attained under the supervision of Colonel Waterhouse, the loss of whose services by retirement is regretted by the Government of India.

In the Mathematical Instrument Office the number of instruments issued largely increased, exceeding in value the issues of the previous year by over a lakh of rupees. Steps have been taken to utilise more fully than hitherto, by repair or conversion, the large stock of defective instruments that has accumulated, and have resulted in a considerable saving to Government.

12. The Survey of India Department continued throughout the year under the administration of Major-General C. Strahan, R. E., and the Government of India desire to acknowledge the efficient manner in which he has controlled its operations, and the value of the work done in all its Branches.

Order.—Ordered that the above Resolution be forwarded to the Surveyor-General of India, the Inspector-General of Forests, the Local Governments and Administrations noted on the margin,* and to the Foreign, Military and Public Works Departments.

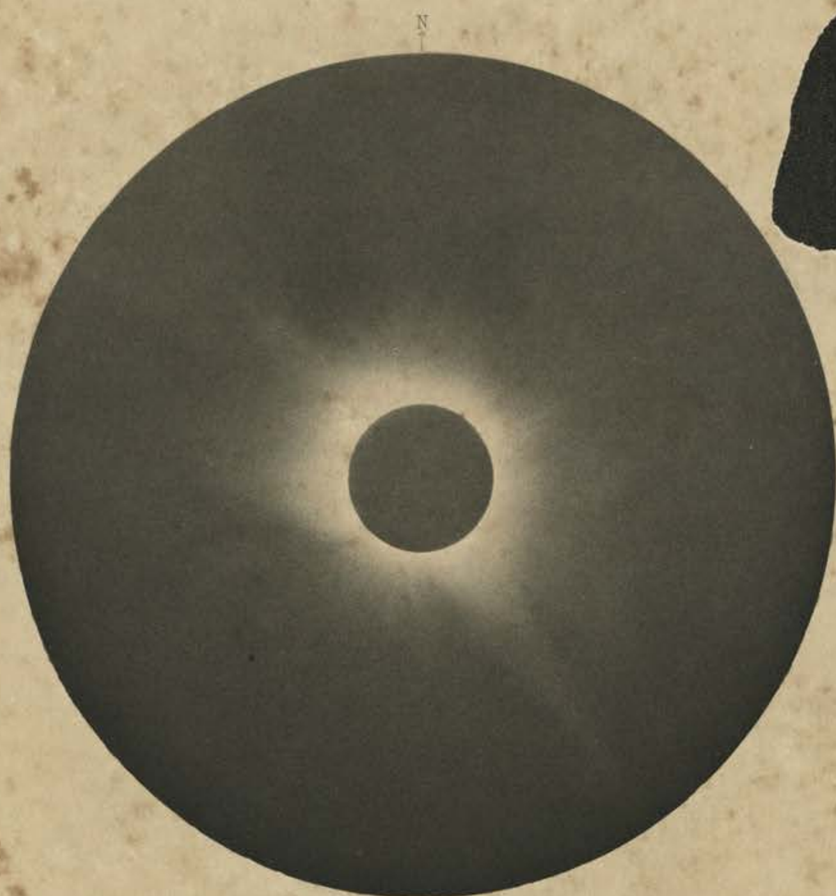
* Madras.
Bombay.
Bengal.
North-Western Provinces and Oudh.
Punjab.
Central Provinces.
Burma.
Assam.
Coorg.

Ordered also that the Resolution be published in the Supplement to the *Gazette of India.*

(True extract.)

DENZIL IBBETSON,

Secretary to the Government of India.



THE TOTAL SOLAR ECLIPSE OF JANUARY 22nd 1898, AT DUMRAON, BIHAR.

Enlarged from a negative by Mr. T.A. Pope, Asst. Surveyor General of India.

Photo-etching. Survey of India Offices, Calcutta, March 1898.

GENERAL REPORT

ON THE

OPERATIONS

OF THE

Survey of India Department

ADMINISTERED UNDER

THE GOVERNMENT OF INDIA

DURING

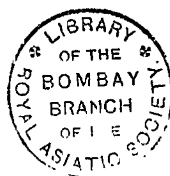
1896-97.

PREPARED UNDER THE DIRECTION OF

MAJOR-GENERAL C. STRAHAN, R.E.,

SURVEYOR-GENERAL OF INDIA.





CALCUTTA:
OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.
1898.

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8, HASTINGS STREET.

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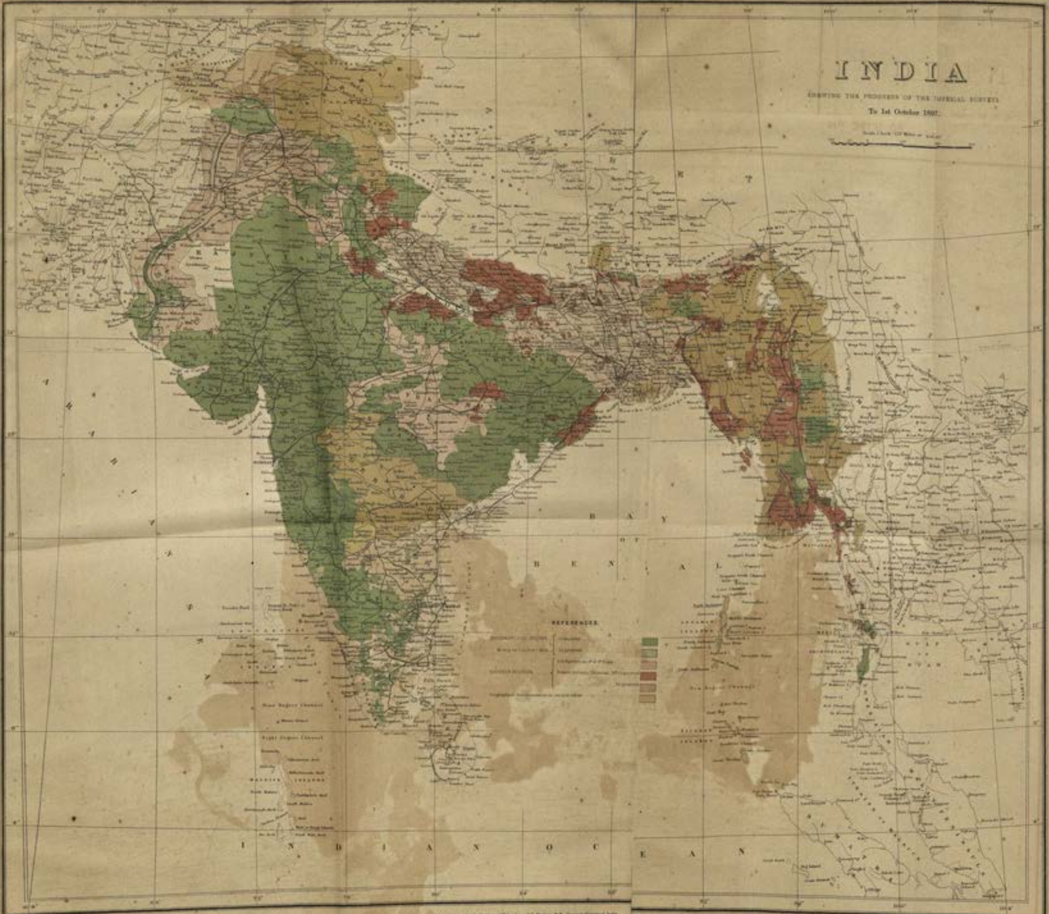
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TO THE

GREAT TRIGONOMETRICAL SURVEY

OF

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CEYLON

GENERAL REPORT

ON THE

Operations of the Survey of India

DURING THE SURVEY YEAR

1896-97.

PART I.

SUMMARY.

ADMINISTRATION.

1. The operations that are now reported on are for the survey year ending 30th September 1897.

2. The general administration of the Department and the superintendence of the Topographical Branch remained in the hands of Major-General C. Strahan, R. E., Surveyor-General of India, throughout the year. The Revenue Branch was under the superintendence of Colonel J. E. Sandeman, I. S. C., up to 18th April 1897, when he proceeded on furlough. During his absence Colonel R. G. Woodthorpe, C.B., R.E., was appointed to officiate as Deputy Surveyor-General in charge Revenue Branch, but as he was himself on furlough at the time and suffering from the effects of malaria, Lieutenant-Colonel J. R. Hobday, I.S.C., acted for him until the close of the year. Lieutenant-Colonel St. G. C. Gore, R.E., continued to be Superintendent of the Trigonometrical Surveys throughout the year, except for a short period of one month, when Captain G. P. Lenox-Conyngham, R.E., conducted his duties

3. The Bengal Government having decided that the Bihár Survey parties should be reduced from four to two cadastral sections, it was proposed that Captain Crichton should, in addition to his administrative duties as Superintendent of Settlement Surveys, take over the executive charge of the Bihár Surveys; this change was sanctioned by the Government of India in their letter No. $\frac{1308}{40\text{-}6}$ dated 3rd June 1896.

Inspection Tours of the Administrative Officers.

4. On the 19th April 1897, the Surveyor-General proceeded to Dehra Dún, where he inspected the Great Trigonometrical Office and the training school which has lately been started there and which will in time be of very great service to the department generally. The work being done by it will be found in paragraph 49 on page 12. Major-General C. Strahan then visited Mussooree, meeting the several survey officers from the North-Western Provinces, Bengal and elsewhere, who had just returned from the field. On the 2nd May he arrived at Simla where he remained until the 17th July, inspecting the offices of No. 18 (Himálaya) Party and the Simla Drawing Office during his stay there. On his return to Calcutta he again visited Dehra and consulted with the Superintendent Trigonometrical Surveys, on various subjects.

On the 31st August, Major-General C. Strahan again left Calcutta for Bangalore and Poona, inspecting the offices of the following parties which were recessing at those two stations, *viz.*: Nos. 9, 10, 14, 19, 20 and 21 at Bangalore, and Nos. 17 and 25 at Poona. He returned to Calcutta, *viâ* Mussooree, where he met Lieutenant-Colonel Hobday, Mr. G. B. Scott and

Captain Crichton, and consulted with those officers on sundry matters connected with the future progress and conduct of the surveys in the North-Western Provinces and Bengal. He also inspected the office of No. 12 Party, which had been allowed to recess at Mussooree instead of Kurrachee on account of the plague at the latter place. He returned to Calcutta on the 14th October.

5. Colonel Sandeman, Deputy Surveyor-General, Revenue Branch, left Calcutta on 14th December 1896, and proceeded to Madras to inspect the Forest Survey Parties in the field, No. 19 Party at Rénigunta in North Arcot district, and No. 9 Party at Trichinopoly, and returned to Madras on 4th January 1897. He then sailed for Rangoon to inspect the Cadastral and Forest Survey Parties in Burma. At Rangoon he interviewed the Lieutenant-Governor and Financial Commissioner; also attended a meeting at the Municipal Office, Mr. Hall the President being present, when a decision was arrived at to continue the Rangoon Town survey and to apply for an additional grant for its completion by the end of November 1897. He then inspected the maps and records of No. 7 (Lower Burma) Cadastral Party, and on the 17th January proceeded to Pyuntaza in Pegu district, where one of the field camps of the party was at work. On 19th January he arrived at Mandalay, and commenced inspecting No. 3 (Upper Burma) Cadastral Party on 21st idem, proceeding on 25th to Pagan to one of the cadastral field camps, and returned on 29th to Mandalay, where he interviewed the Inspector-General of Forests. He left Mandalay on 31st for Kanyutkwin to inspect No. 20 (Forest Survey) Party, marched into the forests, and examined the field work, returning to Rangoon on 6th February. Here he interviewed the Chief Secretary, the Revenue Secretary, the Director of Land Records and the President of the Municipality; the last mentioned informed him that the estimate for the increased expenditure for the completion of the Rangoon Town survey had been passed by the Municipality. He then inspected some of the topographical sheets done by No. 7 Party in Thatôn district, and personally examined and checked in the field several sheets of the Rangoon Town survey, and eventually returned to Calcutta on the 18th February 1897.

6. Colonel Sandeman obtained furlough for 1 year and 125 days from 1st May 1897, and availed himself of preparatory leave on 19th April, when he handed over his duties to Lieutenant-Colonel Hobday, who left Calcutta on 20th May for Shillong, where he arrived on 25th and inspected No. 6 (Assam) Party. During his stay, he interviewed the Chief-Commissioner, Chief Secretary, and Director of Land Records, and made certain proposals regarding the desirability of retaining the survey party in Assam, which were favourably received by the Chief-Commissioner. He left Shillong on 9th June (3 days before the great earthquake), and arrived in Calcutta on 13th June. On 5th July he sailed for Rangoon to inspect No. 7 (Lower Burma) Cadastral Party. Here he also met the officer in charge, No. 3 (Upper Burma) Cadastral Party, and discussed several matters connected with cadastral surveys in Upper Burma. He also interviewed the Lieutenant-Governor, Chief Secretary, and Revenue Secretary. On 16th July, he sailed for Madras, arriving on 20th, and proceeded to Bangalore to inspect Nos. 9 and 19 (Madras Forest) Parties, and No. 20 (Burma Forest) Party at their recess quarters. An arrangement was made for the amalgamation of Nos. 9 and 19 into one combined party. He left Bangalore on 31st July and returned to Calcutta on 4th August. On 6th September he then started for Náini Tál, to inspect No. 8 (North-Western Provinces) Traverse Party, interviewed the Senior Member of the Board of Revenue, and Chief Secretary, and attended a meeting of the Board, when it was decided to amalgamate Nos. 2 and 8 Traverse Parties; also to establish a drawing office for the mapping of the standard sheets of the North-Western Provinces and Oudh. Lieutenant-Colonel Hobday then left Náini Tál on 20th September for Mussooree, arriving on the following day. Here he inspected No. 2 (North-Western Provinces) Traverse Party and No. 4 (Bihár) Cadastral Party, and returned to Calcutta on 14th October.

7. Lieutenant-Colonel St. G. C. Gore, R.E., Superintendent, Trigonometrical Surveys, on his return from furlough inspected No. 25 Party (Tidal and Levelling) in October, the recess offices of Nos. 14 and 24 Parties at Mussooree in May, and the Office of No. 18 Party at Simla in June. In January the Superintendent visited Calcutta to hold a conference with the Surveyor-General,

FIELD PARTIES.

8. The field operations of the year under report were carried on by 21 parties and one detachment. Of these, one party was employed on trigonometrical surveys; six parties on topographical surveys; five parties on forest surveys; three parties and one detachment on cadastral surveys; one party on topographical and traverse work; two parties on traverse surveys; and three parties on scientific operations. The operations of the Forest Survey Branch were also continued during the year. The Land Records surveys carried on by local agency in the North-Western Provinces and Oudh, which are under the superintendence of the Deputy Surveyor-General, Revenue Branch, have also been included in this report under the head of Cadastral Surveys.

9. The following tabular statement shows the whole of these operations grouped according to the scope and nature of the work on which the parties were severally employed:—

Statement of Survey Operations and Parties.

No. of Party.	Nature and *locale* of operations.	Page in this Report.	Executive Officers.	Scale of Survey.	Administrative Superintendent.
	Trigonometrical Survey.				
24	Balúchistán	15	Captain J. M. Burn, R.E.	......	Supdt., Trig.
	Topographical Surveys.	...			
10	Upper Burma	16	Mr. A. J. Gibson Major F. B. Longe, R.E. Captain A. J. Pilcher, R.E.	1" = 1 mile for reproduction	D. S. G., Topo.
11	Ditto	18	Captain T. F. B. Renny-Tailyour, R.E.	4" = 1 mile for reproduction	Ditto.
12	Sind	20	Captain G. B. Hodgson, I.S.C.	2" = 1 mile for reduction	Ditto.
15	Balúchistán	24	Colonel Sir T. H. Holdich, R.E. Captain H. A. D. Fraser, R.E. Mr. T. E. M. Claudius	Various scales	Ditto.
18	Himálayas	25	Captain C. L. Robertson, R.E. Mr. L. J. Pocock Mr. C. D. Potter	4" = 1 mile for reproduction and reduction to half scale, and 2" = 1 mile for reproduction.	Supdt., Trig.
21	Upper Burma	19	Major F. B. Longe, R.E. Captain A. J. Pilcher, R.E.	4" = 1 mile for reproduction	D. S. G., Topo.
6	Assam	65	Mr. E. C. Barrett Mr. W. H. Penrose	1" = 1 mile for reproduction	D. S. G., Rev.
	Forest Surveys.				
9	Madras	33	Mr. E. J. Jackson Captain H. A. D. Fraser, R.E.	4" = 1 mile for reproduction.	Ditto.
14	Central Provinces	28	Mr. C. F. Erskine	4" = 1 mile for reproduction	Supdt., Trig.
17	Bombay	30	Major W. J. Bythell, R.E. Mr. C. E. Tapsell	16" = 1 mile, 8" = 1 mile and 4" = 1 mile for reproduction	D. S. G., Topo.
19	Madras	35	Captain H. A. D. Fraser, R.E. Captain C. H. D. Ryder, R.E. Lieutenant A. H. B. Hume, R.E.	4" = 1 mile for reproduction	D. S. G., Rev.
20	Burma	36	Captain P. J. Gordon, I.S.C. Lieutenant H. J. Hare, R.E.	4" = 1 mile and 2" = 1 mile for reproduction.	Ditto.
	Forest Survey Branch.				
	Central Provinces Punjab Burma	38 39 40	Mr. W. H. Reynolds Ditto Ditto	4" = 1 mile for reproduction	I. G. Forests.
	Cadastral Surveys.				
3	Upper Burma	41	Mr. G. H. Cooke Mr. E. G. Little	16" = 1 mile and 8" = 1 mile	D. S. G., Rev.

Statement of Survey Operations and Parties—concld.

No. of Party.	Nature and *locale* of operations.	Page in this Report.	Executive Officers.	Scale of Survey.	Administrative Superintendent.
	Cadastral Surveys—contd.				
4	Bihár	46	Captain R. T. Crichton, I.S.C. Captain C. W. H. Symonds, I.S.C.	16″=1 mile	S. S. S., Bengal.
7	Lower Burma	52	Mr. B. G. Gilbert-Cooper Mr. W. C. Price	16″=1 mile	D. S. G., Rev.
Land Records Surveys.	North-Western Provinces and Oudh.	56	Mr. G. B. Scott	16″=1 mile	Ditto.
	Traverse Surveys.				
2	North-Western Provinces and Oudh.	59	Captain J. M. Fleming, I.S.C. Mr. W. S. Buttress	16″=1 mile (skeleton plots)	Ditto.
6	Assam	65	Mr. E. O. Barrett Mr. W. H. Penrose	......	Ditto.
8	North-Western Provinces and Oudh.	62	Mr. J. S. Pemberton	16″=1 mile (skeleton plots)	Ditto.
	Geodetic.				
22 23	India	67	Captain S. G. Burrard, R.E. Mr. J. Eccles, M.A. Captain G. P. Lenox-Conyngham, R.E.	......	Supdt., Trig.
	Tidal and Levelling operations.				
25	India	68	Captain S. G. Burrard, R.E. Captain C. C. D. Morice, R.E. Mr. G. Belcham	......	Supdt., Trig.

OUTTURN.

10. During the year under report the aggregate area surveyed on all scales amounts to 104,987 square miles, of which 78,718 square miles were reconnaissance only. The report of last year shows an area of 63,653 square miles; the increase this year is due to the large amount of reconnaissance completed in Upper Burma, and elsewhere. The aggregate area of rigorous survey on all scales amounting to 26,269 as against 33,374 square miles last year. These areas are exclusive of those embraced by the traverse operations in the North-Western Provinces and Oudh and Assam, carried on for the purpose of furnishing a correct skeleton on which to base the field surveys under the Settlement Department; the area thus traversed during this year amounts to 6,135 square miles, whilst that of last year was 8,719 square miles.

The operations of the various field parties will be found summarized in the following paragraphs. A more detailed report on the operations of each party for the year under review is given in Part II.

TRIGONOMETRICAL SURVEYS.

11. The Principal triangulation of the Makrán Longitudinal Series was continued from the most western stations of last season's work, *viz.*:—Kuliri and Piaro in Longitude 66°30′, and was extended westwards over a direct distance of about 75 miles, comprising 3 figures and embracing an area of 1,380 square miles. Horizontal and vertical angles were taken at 9 principal and 2 secondary stations and astronomical observations were taken at one of the former.

TOPOGRAPHICAL SURVEYS.

12. On topographical operations six parties have been employed, *viz.*, Nos. 10, 11 and 21 in Upper Burma, No. 12 in Sind, No. 15 in Balúchistán, and No. 18 in the Himálayas.

13. No. 10 Party having completed its work in the Southern Mahrátta country last season, was transferred to Upper Burma. The area surveyed in detail by the three parties amounted to 5,747 square miles, including 967 square miles of overlap, whilst 8,690 square miles were triangulated in advance. As the surveyors of No. 10 Party were not only entirely new to the style of country to be surveyed, but were also many of them Mahrátta Bráhmins who strongly object to serving away from their own country, more especially in such a wild jungly country as that of Upper Burma, the progress made by that party was not as much as it should have been. This will be remedied during the coming season, and it is confidently expected that, what with that and an increase to the native establishments of Nos. 11 and 21 Parties, the area turned out next year in the Shan States will be considerably increased.

No. 12 Party continued the survey of Sind on the 2-inch scale. The area completed amounted to 2,244 square miles No work was done by this party on the 1-inch scale, but an area of 1,825 square miles in the hilly portion adjoining Balúchistán was surveyed by a detachment of No. 15 Party. A survey of the Layari quarter of Kurrachee on the scale of 80 feet=1 inch was also completed. The cost rate of the 2-inch survey, exclusive of triangulation and traversing, is R14·2 per square mile, which, as was expected, is much less than the cost rate of last year. The area traversed amounted to 3,635 square miles at a cost rate of R9·1 per square mile; the traversing includes a survey of the village boundaries which are fixed by offsets.

No. 15 Party was employed on geographical reconnaissance and in topographical work in Sind, besides this were several minor surveys. One Sub-Assistant Superintendent, Khan Bahadur Imam Sharif, was also deputed to Zanzibar to undertake a survey of that island.

No. 18, the Himálaya Party, completed a total area of 810 square miles, of which 446 square miles were surveyed on the 4-inch scale, and 364 on the 2-inch scale. The 2-inch work consists of topography in Mandi, Suket and Simla Hill States, and in Sirmur, and the 4-inch in Kángra, Kullu, Sirmur, Patiála and Kalsia (revision survey).

Classification of forests and soils was carried out in 191 square miles of country topographically surveyed in British territory. The large scale (48 inches=1 mile) survey of the town of Náhan was begun.

Small areas were also topographically surveyed on various scales in Assam, Burma, Bengal and Punjab by No. 6 Party, by No. 7 Cadastral Party, by No. 4 Party and by the Forest Survey Branch.

14. The areas topographically surveyed on various scales during the year amount to 14,460 square miles against 19,798 square miles executed last year.

The decrease in the area completed is due to the fact that the ½ inch work of No. 15 Party was almost finished last year, and only 700 square miles were executed instead of 11,307 square miles, as noted in last year's report. The outturn of work on other scales has increased.

The total is made up as follows :—

700	Square miles surveyed on the		½	inch scale.
8,374	"	"	1	"
4,841	"	"	2	"
255	"	"	4	"
21	"	"	6	"
2	"	"	8	"
56	"	"	12	"
211	"	"	16	"

FOREST SURVEYS.

15. In addition to the four survey parties which continued the operations in the Central Provinces, the Bombay and Madras Presidencies and in Lower Burma, the traverse party from the Central Provinces was transferred to the Madras Presidency to expedite the survey of the forest reserves, maps of which are required as soon as possible. The Forest Survey Branch continued its operations in Central Provinces, Punjab, Upper and Lower Burma. Small areas were also surveyed by the party working in the Himálayas.

16. In the Central Provinces, the detail survey of the forests in the Damoh District, as allotted to No. 14 Party was brought to a close. Operations were begun in district Biláspur and triangulation and traversing in advance of topography were carried on simultaneously in districts Damoh, Biláspur and Sambalpur. The total outturn of topography, on the 4-inch scale, during the season was 696·6 square miles, of which 622·7 square miles were in Damoh and 73·9 square miles in Biláspur. The area triangulated in advance was 666 square miles in Biláspur and 1,104 square miles in Sambalpur. But owing to the forest blocks being scattered over large extents of country, of the above areas only 240 and 390 square miles, respectively, will be brought under actual survey.

The usual classification of forest growth and soils was carried out over the area surveyed in detail.

The traversing in advance of topography consists of 356 linear miles. The cost rate per square mile of the detail survey is R70·5. Under the orders of Government the remaining portion of the work in districts Biláspur and Sambalpur was transferred to the Forest Survey Branch for completion.

17. The operations in the Bombay Presidency comprised the detail survey on the 8-inch scale of teak reserves in the Thána district, the completion of 4-inch detail survey in the Poona district, the 8-inch survey of teak reserves, the 4-inch survey of ordinary forest reserves, and the 16-inch survey of *bábul* reserves in the Ahmednagar district; the detail survey on the 4-inch scale in North Kánará. The areas completed amounted to 522 square miles on the 4-inch, 168 square miles on the 8-inch, and 33 square miles on the 16-inch scales. In addition to this 1,376 square miles were triangulated. The cost rates are slightly higher than those of last year, which were exceptionally low, but compare favourably with other years.

18. Two full parties were employed in the Madras Presidency, one party having been transferred from the Central Provinces, as already mentioned; this latter party had, however, been employed for years on traverse operations, and the native surveyors were consequently more or less unacquainted with the topographical operations they were called upon to undertake in Madras, and hence the outturn has not been as much increased as it would have been had the men been trained topographers; during the first year in new country the outturn of detail survey can never be very large, owing to the want of triangulation or traverse work in advance. The two parties together completed 1,148 square miles of detail survey on the 4-inch scale, 2,450 square miles of advance triangulation, and 1,252 linear miles of traversing. There should be a considerable increase of detail survey during the next field season.

19. In Lower Burma an area of 395 square miles on the 4-inch and 106 square miles on the 2-inch scales were completed in the Shwegyin and Pegu forest divisions in the Toungoo district. The outturn of 4-inch survey shows a satisfactory increase on former years. The cost rate shows a small increase on that of last year.

20. The party working in the Himálayas surveyed an area of 191 square miles on the 4-inch scale in Sirmur, Patiála, Kullu and Kángra.

21. With the exception of the surveys in Oudh, which were brought to a close last year, the operations of the Forest Survey Branch were in continuation of those of last year, but in addition a new survey in the Ruby Mines district was commenced. In the Central Provinces, surveys were carried on in the forest divisions of Ráipur, Bálághát, Nágpur-Wardha, Seoni, Chhindwára and Saugor; in Chamba in the Punjab; in Salween-Ataran, Pyinmána, and the Ruby Mines in Burma. The total area surveyed amounts to 2,365 square miles, of which 802 square miles were done on the 1-inch scale for topographical purposes only.

22. The total outturn of forest surveys executed on various scales during the year amounts to 4,823 square miles, of which 1,563 were surveyed by the Forest Survey Branch. The area surveyed by the Imperial Survey parties, *viz.*, 3,260 square miles, is 58 square miles in excess of that surveyed last year.

The areas on the different scales are as follows:—

106	square	miles	surveyed	on the	2-inch	scale,
4,310	"	"	"	"	4-inch	"
168	"	"	"	"	8-inch	"
239	"	"	"	"	16-inch	"

CADASTRAL SURVEYS.

23. The number of parties engaged on cadastral operations during the year has been as follows:— One party and one detachment in Bengal, one in Upper Burma, and one in Lower Burma. In addition to the operations of the Imperial parties, cadastral surveys have been carried on by local agency in the North-Western Provinces and Oudh, under the immediate superintendence of Mr. G. B. Scott, Superintendent of Settlement Surveys, and the general professional control of the Deputy Surveyor-General, Revenue Branch.

24. Owing to the famine in North Bihár, the programme of the Bengal party had to be somewhat modified; areas, which were least likely to suffer, had to be selected for survey. The programme consisted mainly of the cadastral survey and preparation of the record of rights of certain private estates in districts Sáran and Darbhanga and of certain temporarily settled and Government estates of smaller area in the Noákháli district, Chittagong, and in the Midnapur district of the Bhágalpur division. A reduction in the strength of the cadastral survey party in Bihár having been decided on, Captain Crichton, Superintendent of Settlement Surveys in Bengal, took over executive control of the Bihár surveys in addition to his other duties. As in previous years the survey establishments have been utilised as part of the Settlement Department, one *amin* surveying the village and writing the records during the field season, whilst during the recess season the same man extracted the areas and completed the village records and statistics.

25. The following is a summary of the progress of work in each district:—

In Sarán an area of 210 square miles was cadastrally surveyed at a cost rate of R142·03 for survey, and R128·62 for records. These abnormally high cost rates are due to the alteration and contraction of the original survey programme in this district, on account of the famine in Bihár. An area of 25 square miles of *diara* lands (lands subject to inundation from rivers) on the 16-inch scale at a cost of R56 per square mile was also completed topographically.

In Darbhanga an area of 545 square miles was cadastrally surveyed at a cost of R78·31 per square mile for survey and R87·47 for records. Also an area of 40 square miles of *diara* lands was topographically surveyed on the 16-inch scale at a cost of R27 per square mile.

In Noákháli an area of 84 square miles of certain Government estates in the islands of Sandip and Hatiya was cadastrally surveyed together with the record of rights at a cost of R89 per square mile for detail survey and R58·5 for records. In addition to this certain other Government estates comprising an area of 146 square miles were topographically surveyed on the 16-inch scale at a cost of R12 per square mile, including traversing: and 199 square miles of *diara* lands on the 2-inch scale at a cost of R6 per square mile.

Small estates in districts Muzaffarpur and Monghyr comprising an area of 2 and 1 square miles respectively were cadastrally surveyed, whilst a special test survey on a scale of 32 inches = 1 mile of an area comprising 3 square miles of the Majnamutha estate was undertaken for the purpose of testing an old survey.

26. The Upper Burma party continued the cadastral surveys in the following districts:—

District.	Area in square miles.	Cost rates per square mile.
		R
Myingyan	781	124·3
Minbu	57	74·9
Upper Chindwin	129	130·4
Katha	229	104·2
Shwebo	46	161·4
Yamèthin	56	74·9
Mandalay	2	75·0

Also an area of 2 square miles was surveyed on the 8-inch scale of the gold tracts in district Katha. The traverse survey of Myingyan is now complete, and only about 1,000 square miles of cadastral survey remain to be done. The survey of Minbu is also nearly completed.

In the Upper Chindwin and Katha districts the areas for cadastral survey were small and much scattered, which caused loss of time and extra expense,

whilst the excessive unhealthiness of the climate especially in Katha added much to the difficulties of the surveyors.

27. The Lower Burma party cadastrally surveyed an area of 509 square miles, *viz.*, 450 square miles in Pegu district, and 59 square miles in Toungoo district, at a cost of R151 per square mile. Progress was much retarded in these two districts by the unhealthiness of the climate, an average of nearly one-fifth of the menial establishment being incapacitated for work throughout the season from dysentery and fever. In Thatôn district 58 villages embracing an area of 41 square miles on the 2-inch scale was re-surveyed on account of changes in the bed of the Sittang river, and extensions of cultivation, at a cost of R35 per square mile. An area of 452 square miles was also topographically surveyed by this party in Thatôn district, on the 2-inch scale at a cost of R58·5 per square mile. The survey of the town of Rangoon, partly on the scale of 50 feet and partly on that of 100 feet to the inch, which was commenced last year, was completed.

28. In the North-Western Provinces and Oudh settlement surveys were continued by *patwári* agency in districts Meerut, Lálitpur, Bahraich, Sítápur, Sháhjahánpur, Kheri and Bareilly under the executive control of Mr. G. B Scott, Superintendent of Settlement Surveys, subject to the supervision of the Deputy Surveyor-General, the work in each district being superintended by an officer of the Provincial service of the Imperial Survey. The total area surveyed in the North-Western Provinces and Oudh amounts to 4,325 square miles, at an average cost of R45 per square mile These surveys are based on traverses run by Nos. 2 and 8 parties. In Lálitpur owing to the famine the *patwáris* were withdrawn from survey work during a considerable portion of the field season, and *amins* had to be employed in their stead. In Bareilly also the work was hampered by the famine. The survey and record writing of the Meerut district and of the Lálitpur sub-division have been completed, and it is anticipated that the surveys of Bahraich and Sháhjahánpur will be finished next year.

29. The total areas cadastrally surveyed during the year in the different provinces, including 211 square miles in which the details of fields have not been shown, are as follows:—

	Square mile.
Bengal	1,056
Burma	1,809
North-Western Provinces and Oudh	4.325
	7,190

The reduction in the total area completed as compared with last year's return is due to the curtailment of the programme in Bengal on account of famine and in Burma, because the survey operations had outstripped the settlement work.

TRAVERSE SURVEYS.

30. Two parties were employed during the year, in the North-Western Provinces and Oudh, on these operations, to furnish a skeleton basis for the Settlement Surveys now being carried on by local agency, whilst a third party was employed on similar operations in Assam, in order to locate geographically certain areas cadastrally surveyed by local agency in the Brahmaputra Valley, and of certain *ilam* lands and tea grants in the Surma Valley.

31. In the North-Western Provinces and Oudh, two parties Nos. 2 and 8, were employed on traverse operations. The former completed an area of 3,005 square miles, of which 237 were in the Sháhjahánpur, 1,600 in the Kheri, and 1,168 in the Pilibhít districts at an average cost rate of R27 per square mile No. 8 Party was employed in districts Meerut, Bareilly, Bijnor and Gonda, in which the areas traversed were 175, 744, 403 and 1,004 square miles respectively, or a total of 2,326 square miles at a cost rate of R29 per square mile.

These traverse surveys are to furnish correct plots on which to base the cadastral maps which are made by *patwari* agency under Mr. Scott, Superintendent of Settlement Surveys.

32. In Assam, No. 6 Party completed the traversing of an area of 596 square miles in the Brahmaputra Valley, *viz.*, 287 square miles in the Goálpára, and 309 square miles in the Kámrúp districts at a cost of R30 per square mile.

In the Surma Valley 208 square miles were traversed in Sylhet district at a cost of R26 per square mile. In addition to this, an area of 629 square miles was topographically surveyed in the Assam Valley on the 2-inch scale by this party at a cost of R43·7 per square mile.

33. The areas traversed during the year, exclusive of the preliminary traversing connected with the cadastral surveys made by this Department, are as follows :—

	Square miles.
North-Western Provinces and Oudh	5,331
Assam	804
Total	6,135

SPECIAL OPERATIONS.

34. Observations for redetermining the value of the latitude of Madras were taken by Captain S. G. Burrard, R.E., with the Zenith Sector, and the result, combined with a value obtained by Mr. Michie Smith and two previous values, gives a mean value for Madras of 13°-4′-8″·02 north latitude.

35. The Tidal observations have been continued as usual. Observations with the self-registering tide-gauges have been made at 12 stations in India, Burma, the Persian Gulf, the Andaman Islands and the Red Sea. During the coming year it is intended to dismantle the observatory at Muscat and possibly also that at Bushire, and to open new observatories at Perim, Porbandar, and perhaps Port Albert Victor.

36. In connection with the tidal operations, spirit-levelling was carried on from Potanghi to Vizianagram, and from Biláspur to Katni within 150 miles of the terminus at Allahabad. The total out-turn amounts to 291½ miles of double levelling, fixing 23 embedded bench-marks, 298 ordinary bench-marks, 8 verificatory points, and 5 stations of the Great Trigonometrical Survey.

GEOGRAPHICAL SURVEYS AND RECONNAISSANCES.

37. In Upper Burma an area of 11,718 square miles of new country was geographically surveyed on the ¼ inch scale by Nos. 11 and 21 Parties; 2,000 square miles of triangulation were also completed.

38. The aggregate areas geographically surveyed during the year on the eastern and western frontiers amount to 78,718 square miles.

HEAD-QUARTERS OFFICES.

39 The details of the work done at the various offices at the head-quarters are given in Part III of this Report.

40. The offices located in Calcutta were, as usual, in charge of three Assistant Surveyor-Generals. The Drawing, Engraving and Map Record and Issue Offices, as well as the Bengal Provincial Drawing Office, remained in the hands of Mr. A. E. Spring The Photographic and Lithographic Office remained under the supervision of Colonel J. Waterhouse, I.S.C., until the 8th May 1897, when he was succeeded by Mr. T. A Pope. The Correspondence and Mathematical Instrument Offices were in the hands of Colonel M. W. Rogers, R.E., until 4th February 1897, of Lieutenant-Colonel J. R. Hobday, I.S.C., up to 29th April 1897 and of Major F. B. Longe, R.E., for the remainder of the year.

41. The more important work of the Geographical Section of the Drawing Office has been the completion of the maps of the North-Eastern and South-Eastern Frontiers. Sheet No. 15 N. W. of the North-Eastern Frontier and sheets Nos 4 S. W. and 6 N. E. of the South-Eastern Frontier series on the 4 mile scale have been published, and the latter sheet has also been published on the 8-mile scale. Sheets Nos. 14 S E. and 23 N. E. and N. W. (in one sheet) of the North-Eastern Frontier on the 4-mile scale, and sheets Nos. 3 S. E. and 3 A N. E. of the South-Eastern Frontier on the same scale have been brought up to date as regards railways, etc. Sheet No. 306 of Upper Burma on the 1-mile scale was also published as a preliminary edition.

The general maps of India on various scales have received additions and corrections, and the second edition of the Map of India on the 32-mile scale was brought up to date as far as possible; a new canal map on the same scale was also commenced and will be published very shortly as also the Railway Map on the 48-mile scale. The third edition still awaits orders for publication. The 128-mile Map of India had the hills completed for engraving. The engraved provincial maps on the 16-mile scale of Assam, Bengal including Bihár, Orissa and Chota Nágpur and Punjab were all revised and brought up to date, and those of the Bombay Presidency, Central Provinces and Rájputána Agency were similarly revised for lithography: the Map of Bengal, Bihár, Orissa and Chota Nágpur had the hill shading also completed for engraving. Several standard sheets on the 1-mile scale of the Rájputána Agency, the Central India Agency, and Central Provinces have been completed to margin, twenty-seven having been completed and sixty-eight are still in hand. The sheets of the Atlas of India have as usual formed a large and important part of the work of this section; fifty-eight sheets have been corrected up to date as regards railways, roads and boundaries.

The maps received from field parties were completed and rendered suitable for publication, and a large number of proofs and other data was supplied to district officials.

42. The work of the Revenue Section has been mainly of the usual routine nature. A second edition of the Map of Calcutta and surrounding country on the scale of 1 inch = 1 mile with additions has been passed through press. Thirty-seven sheets of the large scale map of the town of Moulmein have been redrawn in a style suitable for reproduction by photography. Fourteen standard sheets on the 2-inch scale of district Tavoy; 19 standard sheets of the Indus Riverain Survey on the 1-inch scale and 10 standard sheets (in 4 sections each) of Bombay and Burma were received from survey parties, finally examined, corrected, and rendered suitable for photography. Of the old maps, 20 standard sheets of the Indus Riverain Survey, 29 standard sheets of North-Western Provinces and Oudh on the 2-inch scale, 30 sheets of district Náini Tál on the 4-inch scale, and 37 *pargana* or main circuit maps of Bengal on the 1-inch scale were touched up, corrected and brought up to date for republication. Besides these, 51 standard sheets on the 1-inch scale of the North-Western Provinces and 57 maps of Bengal on 1-inch scale were corrected and brought up to date for new editions.

43. In the Cadastral Section 5,493 cadastral sheets were prepared for publication, of which 2,906 belonged to the North-Western Provinces, 2,206 to Burma, 261 to Bengal and Orissa, and 120 to Assam.

44. The Bengal Provincial Drawing Office continued to be employed on the compilation, from maps supplied by cadastral survey parties in Orissa and Bihár, of standard sheets on the scale of 2 inches to a mile for reduction to half. Eleven standard sheets in 44 sections on the 2-inch scale of Orissa were sent to the Photographic Office for reduction to the 1-inch scale. The final press order for 12 sheets (1-inch scale) was passed. Forty-one unpublished proofs (blue prints) were forwarded to District, Railway and Settlement authorities for scrutiny, prior to final publication. By this means the alignment of the East Coast and Bengal-Nágpur Railways which were laid down subsequent to cadastral surveys was obtained. The standard sheets of Orissa are nearly completed and those of Bihár will be put in hand.

The special publication of some of the standard sheets of Orissa on the 2-inch scale for the Department of Public Works (Irrigation Branch), Bengal, was completed.

45. In the Engraving Office, the preparation of the quarter-sheets of the Atlas of India was continued, six new plates having been completed during the year; 50 unpublished plates were in various stages of progress and 93 quarter and 19 full published plates were added to and corrected, whilst 35 new ones were projected. Fourteen district maps for administration reports were completed and 23 others were in hand. The index to the standard sheets of the Bombay Presidency, a new weather chart aud two scale plates were completed. Two brass plates, one with an inscription of the standard bench marks of Calcutta and the other for the Great Trigonometrical Office have also been completed. Of the provincial maps on the 16-mile scale that of Mysore and Coorg with hills was

completed, those of Assam, Central India Agency and Mysore (without hills) were in hand for additions and corrections; Bengal, Bombay, Madras and Rájputána are in various stages of progress. The Punjab and Kashmír Map in four sheets has been constantly in hand for corrections and additions; sheet No. 1 has been completed with hills.

46. In the Photographic and Lithographic Office the outturn of work is again satisfactory. The departmental work performed shows a considerable increase under almost every head, though there was a slight falling off in the amount of work done for other departments. The number of original subjects of all kinds received and reproduced during the year was 7,880 or 860 in excess of last year, and considerably more than in any previous year. Of these, 1,049 were maps and plans, etc., done for other departments, and 5,634 were cadastral maps. The total value of the work done was slightly less than that of last year, being R2,13,518 against R2,19,779.

Owing to the decrease in the work received from other departments, the amount of work turned out by the lithographic and zincographic machines and presses, as represented by the number of copies turned out, is a little less than last year. The number of pulls was practically the same, being 853,945 against 862,623, and of copies 853,072 against 948,057. As, however, the number of original subjects dealt with was larger, the actual amount of work done cannot be said to have fallen off in any respect, as explained in paragraph 434. The machines, presses and printing establishment were kept fully engaged during the whole year. The type-printing work fell off somewhat, owing to a large supply of professional forms for departmental use having been prepared in advance last year. Under this head 529,664 copies were printed from 10,054 items against 668,795 copies from 11,915 items last year. In the Heliogravure and Silver-printing Sections satisfactory increases are recorded. No less than 72,246 prints were made from 131 photo-etched copper plates, or nearly 16,000 prints more than last year.

The more important publications of the year are referred to in Part III, and full details of the work done in every section are, as usual, given in the Appendix.

The experimental work of the year was chiefly carried on in the Heliogravure Section, where marked progress was made in the preparation of half-tone and line blocks for machine printing. The process known in England as "Enameline" was worked out in every detail and promises to be most useful in the speedy reproduction of half-tone subjects in large numbers. Full details of the process will be found in the Appendix.

Under the orders of the Surveyor General, a scheme for the re-organisation of the office, abolishing progressive salaries and placing the entire establishment, together with the photo-zinco. and type-printing staff of the Trigonometrical Branch Office, in one list for the purposes of promotion, was prepared during the year and submitted to the Surveyor-General immediately after its close.

47. In the Map Record and Issue Office the number of new maps and editions of departmental subjects received during the year amounted to 8,148, of which 7,833 were cadastral maps. The total number of maps issued was 2,07,350 and their value R1,57,927, which show an increase of 6,914 in number and R51,225 in value over those of the previous year. The cash sales of maps amounted to R24,659 which shows an increase of R1,152 over last year's figures.

48. In the Mathematical Instrument Office the total number of instruments issued was 50,727 and their value R2,68,704 against 96,673 and R3,54,890 last year. The number of instruments received into store was 61,558 and their value R2,59,405 against 89,022 and R2,88,055 last year. There has been a decrease both in the number and value of instruments received and issued owing to the demand from railways and other large works being less this year than in the previous one. The number of instruments taken from the repairable stock and rendered serviceable was 20,857 and their value R82,453, against 11,547 and R77,323 last year. This shows an increase of 9,310 in number, and R5,130 in value.

In 1887 the gradual increase in the stock of repairable instruments rendered it necessary to obtain from the Government of India an extra establishment at a

cost of R150 per mensem; this was made permanent in 1890; and again in 1889 a further increase to the establishment at a cost of R120 per mensem was obtained. In 1895 a still further increase in the establishment, costing R220 per mensem, was obtained for the conversion of levels. Since these grants were sanctioned 336 levels and 53 theodolites have been converted and issued and all indents for such instruments have been discontinued. The value of the indents for instruments manufactured in England has been greatly reduced in consequence, having fallen from over £13,000 in 1893-94 to less than £4,000 in 1897-98.

49. In the Trigonometrical Branch Office, Dehra Dún, the second edition of the Hand-book of Instructions for the Topographical Branch alluded to in last year's report has been published and issued. A considerable amount of computations in connection with Captain Deasy's exploration work in Tibet and other work was done. The usual meteorological and solar photographic observations were continued. A great deal of extra work on account of the demand for maps for the frontier expeditions was thrown on the Photozincographic Section. The Drawing Section was also kept fully employed during the year.

Of the eight pupils entertained in the training school in June 1896, six passed the qualifying test on examination in September 1896, and were posted to the field parties in the following month. It is very satisfactory to note from the accounts received from the Executive Officer of No. 11 Party, that the four men, who worked under his orders, were found to promise well, and "the result is," he says, "a decided success and certainly a great saving of expense to Government." Eight more pupils were entertained in November 1896, these underwent a full course of training, were examined in September 1897, and have since been posted to field parties.

It is intended that, in future, officers appointed to the Provincial Service shall be attached to this school to receive a regular course of training prior to their being posted to field parties.

50. The Forest Survey Branch Office at Dehra Dún was engaged as usual during the year upon the final computations of the various field detachments; on the up-keep of the Forest Department map records; on the compilation and drawing of special maps; and on the training of surveyors in field work. Seventy-eight special maps on various scales were prepared, of which 24 have been published, 17 were in press and 37 were in progress; of 4-inch standard sheets 101 were published, 65 were in press and 214 were in hand. Two 1-inch standard sheets were also published. Besides the above a considerable amount of colouring, tracing, mounting and other miscellaneous work for forest and district officers was performed.

ESTABLISHMENT.

51. During the year under report the Department has lost the services of five officers of the Imperial list.

Colonel J. Waterhouse, I.S.C., Assistant Surveyor-General and Superintendent, 1st grade, retired on the 10th June 1897, after having served in the Department for 31 years. On account of his skill in photography, Colonel Waterhouse was selected in 1866 as a suitable officer to superintend and develope the photozincographic process of reproducing maps for the Survey Department. The process was then in its infancy and the great improvements in it are due to this officer's skill and exertions. He introduced the collotype process with great success, but this has since been superseded by the system of etching on copper which is used for reproducing photographs and fine or half-tone drawings for which the photozincographic process would not be suitable. In 1871-72 he was attached to the Indian Eclipse Expedition, and again in 1874-75 he was selected to take photographs of the transit of Venus, whilst in 1875 he was placed in charge of the Eclipse Expedition in the Nicobar islands. His name is well known in England and on the Continent, and he has received many tributes to his success, amongst others, medals from the Photographic Societies of Great Britain and of Vienna; a gold medal was also awarded to the reproductions exhibited by his office at the Calcutta Exhibition of 1884-85. He has written several most useful works on the application of photography to the reproduction of maps and drawings of all kinds. The immense development and the

great success of the various methods of reproducing maps and half-tone subjects now in use, are entirely due to Colonel Waterhouse, and his retirement is a serious loss to the Department.

Colonel M. W. Rogers, R. E, Assistant Surveyor-General and Superintendent, 1st grade, retired on the 4th February 1897, after having served for 31 years. He joined the Department in July 1866. He was principally employed on trigonometrical operations in Dehra Dún, Madras, Bombay and in the Mergui Archipelago. During the Kábul War he served as Survey Officer with the 1st Division of the Quetta Field Force, for which he was mentioned in despatches and was made Brevet Major. From 1882, except for short intervals during which he held charge of the Computing Office at Dehra Dún and the Tidal and Levelling operations, he held the office of the Assistant Surveyor-General in charge of the Correspondence and Mathematical Instrument Offices of the Head-Quarters, Calcutta, which post he filled most ably. He was a talented and energetic officer and the loss of his services is greatly regretted.

Mr. G. H. Cooke, Superintendent, 2nd grade, retired on superannuation on the 12th December 1896. He joined the Junior Division of this Department in December 1866 and was promoted to the Imperial service in September 1872. He served in the Central Provinces, Hazáribágh, with the Lushai Expeditionary Force up to June 1872, in the North-Western Provinces, Central Provinces and Bombay in the capacity of assistant as well as in charge up to 1892. From 1893 he held charge of the forest and cadastral operations in Burma.

Captain R. J. H. L. Mackenzie, R.E., Deputy Superintendent, 1st grade, reverted to the Imperial Establishment on the 1st January 1897. He joined the Department in March 1888 and was employed throughout on frontier topographical surveys with the Balúchistán Party. He accompanied the Gumal and Zhob Valley Expeditions in 1889-90, served as Survey Officer with the Miranzái and Khajuri Kach Field Force in 1891-92. He was attached to the Domandi Section of the Anglo-Afghán Boundary Commission in 1895, whence he returned ill and was invalided to Europe.

Captain C. C. D. Morice, R.E., Deputy Superintendent, 2nd grade, reverted to the Imperial Establishment on 1st March 1897. He joined the Department in November 1891, and was attached to the Tidal and Levelling Party throughout his service, except for a short period, when he was attached to the Trigonometrical Branch Office. He held charge of the party for about three months in 1893, for six months in 1895, and from December 1895 to December 1896. Captain Morice is a good mathematician and has done excellent work, but his health broke down mainly from over work and he was obliged to give up service in India.

52. In the Provincial list there were four vacancies, *viz.*, two by the retirement of Messrs A. J. Wilson and A. J. Gibson, and two by the deaths of Messrs. W. J. O'Sullivan and F. A. Peters; three appointments were transferred from the Imperial to the Provincial list by which three supernumerary appointments of Extra Assistant Superintendents, 1st grade, were created during the year. Two appointments in the 4th grade of Extra Assistant Superintendents have, however, been kept vacant.

1896-97. NO. 24 PARTY.

INDEX TO THE CHARTS OF THE PRINCIPAL TRIANGULATION OF THE MAKRÁN LONGITUDINAL SERIES

REFERENCES

Triangulation completed

Do. in progress

NOTE

The numerals (1) (2) indicate the published charts of triangulation on scale of 1 Inch = 4 Miles.

Scale 1 Inch = 48 Miles

20 0 20 40 Miles

60° 61° 62° 63° 64° 65° 66° 67° 68°

28° 27° 26° 25° 24°

B I L U C H I S T A N

I N D

A R A B I A N S E A

Panjgur

Sehwán

Las Bela

Dasht R.

Hab R.

Indus R.

Chárbár

Gwátar

Gwádar

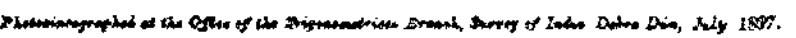
Pasni

Ormára

Karachi

Regr. No. D. 169, S. I. D. - July 97 450

Photozincographed at the Office of the Trigonometrical Branch, Survey of India Dehra Dún, July 1897.



No. 111-S. 97.

PART II.

THE OPERATIONS OF THE SEVERAL FIELD PARTIES.

TRIGONOMETRICAL SURVEYS.

PRINCIPAL AND SECONDARY TRIANGULATION.

BALÚCHISTÁN.

No. 24 PARTY.

Personnel.

Captain J. M. Burn, R. E., Officiating Deputy Superintendent, 1st grade, in charge.
Mr. J. Hickie, Extra Assistant Superintendent, 5th grade.
Mr. P. F. Pranty, " " 6th grade.

53. This party under Captain Burn continued the triangulation westwards of the Makrán Longitudinal Series from the most westerly of the completed stations of last season's work.

54. The triangulation was carried across the Las Bela plain, then across the hilly tracts between this plain and the Jháu plain, closing finally on two stations to the west of Jháu, which are at the eastern extremity of the long Kej valley, in all covering a direct line of some 75 miles.

55. The season's outturn is as follows :—

Horizontal and vertical angles have been taken at nine principal stations.

The principal series has been extended over a direct distance of some 75 miles, embracing an area of 1,380 square miles.

Horizontal and vertical angles have been taken at two secondary stations embracing an area of 520 square miles, while in addition an area of some 1,200 square miles has been embraced by secondary triangulation to intersected points. Astronomical observations for azimuth were taken at one station.

56. The principal observations were taken with Troughton and Simms's 12-inch micrometer theodolite No. 1. The method of observing was to measure angles on nine zeros, two faces on each zero, and two swings on each face.

The mean triangular error was 0·44 seconds, ranging from 0·154 seconds to 1·130 seconds.

57. The party left Kurrachee for the field in October, marching with the strong escort of the Political Agent for South-East Balúchistán, who was also on his way to Las Bela. The Political Agent would not allow work to be started for some time after their arrival in Las Bela, owing to the unsettled state of the country, and early in December the whole work of the party was completely stopped by the obstructive tactics of the local inhabitants. Captain Burn after getting a personal interview with considerable difficulty with some of the headmen in the district concerned, managed by tact and persuasion, to arrange that the party should continue to work in peace until the end of the season in April.

58. The health of the party was on the whole good, though the quality of the water at times was very bad and caused a certain amount of dysentery.

59. Statements showing the details of the outturn of the party, and of the differences between the values of the initial elements of certain stations of the old secondary Makrán Series and of the present principal series will be found in the Appendix.

Captain Burn expresses himself perfectly satisfied with the work of all his assistants.

TOPOGRAPHICAL SURVEYS.

UPPER BURMA.

NO. 10 PARTY.

Personnel.

Major F. B. Longe, R.E., Superintendent, 2nd grade, in charge from 15th November 1896 to 9th April 1897.
Captain A. J. Pilcher, R.E., Officiating Deputy Superintendent, 2nd grade, in charge from 15th April 1897.
Mr. A. J Gibson, Extra Assistant Superintendent, 1st grade, in charge up to 14th November 1896.
Mr. G. D. Cusson, Extra Assistant Superintendent, 5th grade.
" G. T. Hall, " " " " "
" P. J. Serrao, Sub-Assistant Superintendent, 1st grade.
" J. A. Freeman, " " 2nd "
15 Sub-Surveyors, 4 Apprentices.
1 Writer and 1 Hospital Assistant.

60. Mr. A. J. Gibson, Extra Assistant Superintendent, 1st grade, who had held charge of the party from the 10th July 1896, on which date Captain A. J. Pilcher was granted sick leave, handed over charge to Major F. B. Longe, R.E, on the 15th November 1896, the date on which he had completed the records of the party as far as its previous work in the Bombay Presidency was concerned; he then retired on superannuation pension. Under Major Longe it commenced its new work in Upper Burma. On that officer's being ordered to officiate as Assistant Surveyor-General at the Head-Quarters Office, Calcutta, the direction again devolved on Captain A. J. Pilcher, R.E., who, having rejoined, was attached to the party and assumed charge of it on the 15th April 1897.

61. The party which had for many years' been employed in the Bombay Presidency was this year transferred to Burma with recess quarters at Bangalore. With a view to its services being made the most of, it was temporarily amalgamated, so far as its work was concerned, with No. 21 Party and was occupied in surveying portions of the Northern and Southern Shan States and the Mandalay and Ruby Mines districts. No large defined area was told off to it, but its members were employed on ground considered most suitable to their capacities; but few of the sub-surveyors had ever been employed in such hilly jungly country.

62. The party left recess quarters at Poona about November 9th, arrived in Mandalay on the 20th, and thence the various detachments were sent into the field, work being commenced about the 1st December.

63. The only area specially told off to this party was the unsurveyed portion of sheets Nos. 257, 258, 259 and 260, and for this purpose a detachment of 5 surveyors under Mr. Serrao was formed, to be strengthened later on if necessary. This detachment, notwithstanding the energy displayed by the officer in charge, failed to carry out its programme, and, with the exception of sheet No. 260, the rest of the work had to be abandoned; many of the surveyors fell sick and the work was beyond their capabilities. Some were invalided and the remainder employed on easier ground in the North Shan States.

64. The triangulation of sheets Nos. 257 to 260 was supplemented or completed by Mr. Serrao, while Mr. Hall connected that of No. 21 Party of the previous season with that of No. 11 Party on the southern edge of sheet No. 402. At the same time Captain Pilcher extended and supplemented that in sheet No. 304. The remainder of the party was employed in plane-tabling, Mr. Cusson being in charge of a detachment of surveyors of both Nos. 10 and 21 Parties.

65. The outturn for the season is as follows:—

	Square miles.
Triangulation	2,503
Topography on 1-inch scale (including 236 square miles overlap)	1,961

This, considering the strength of the party, is poor, but allowances must be made for the fact that the men were all quite new to the people and country, and the latter being of a very intricate description and mostly covered with thick forest, more or less staggered the surveyors, who had of late years been accustomed to the undulating and almost treeless tracts of the Bombay Presidency.

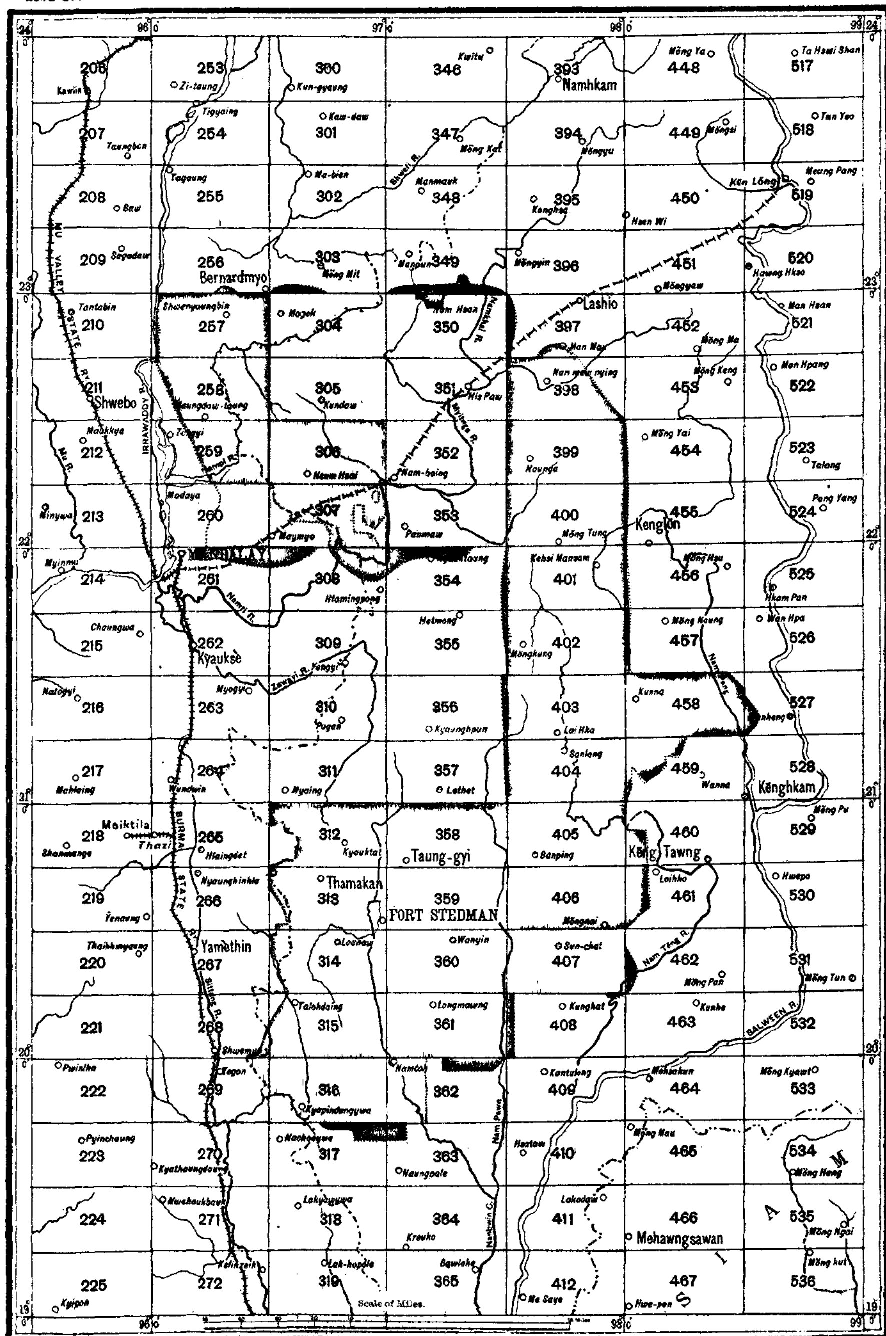
66. The country on the west (sheets Nos. 257 to 260) which was allotted to the surveyors is very hilly, consisting, as it does, of the western slopes of the Ruby Mines hills and of the Shan plateau; this area is all the more difficult on account of the paucity of paths and villages. It is also very feverish in the early part of the cold weather.

The remainder of the country is hilly and mostly forest-clad, but well populated and intersected by paths in all directions.

UPPER BURMA SURVEY.

INDEX TO THE TOPOGRAPHICAL SURVEY IN UPPER BURMA & SHAN STATES.

1896-97. Nos 10,11 & 21 PARTIES.



Reg. No 370, S. I. D.—Jan. 98.—550.

Photo. S. I. O., Calcutta.

REFERENCES.

1" = 1 Mile

Area previously Surveyed

Surveyed in Season 1896-97

Triangulated in advance

NOTE.

The numerals 312, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

No. 302-S. 98.

The inhabitants are Burmans, Shans and Palaungs, the latter inhabiting almost exclusively the hills north of the Maymyo-Lashio road, the two former remaining for the most part in the valleys and on the Shan plateau, where they cultivate rice, etc., while the Palaungs, especially throughout Tawng Peng, cultivate tea (called Let-hpet) which they export in large quantities, after it has been "pickled": throughout the field season large caravans of oxen were to be seen carrying it to Mandalay to be distributed over the whole of Burma.

67. The health of the party during the field season except in the case of the detachments in sheets Nos. 257 to 259 was good, and much of the sickness in these parts was due to want of care and energy on the part of the surveyors. During recess, however, as has been so frequently noticed by the officer in charge of No. 21 Party, the effects of the climate showed itself, and most members suffered from fever and other complaints.

68. Field operations ceased on the 15th May, and the party left Rangoon for Bangalore on the 21st, the recess office being opened there on June 3rd.

69. During recess the computations have been completed, and the party assisted No. 21 Party in the drawing of sheets Nos. 260, 305, 351, 352 and 353. Sheets Nos. 304 and 350 have also been partially drawn. These sheets have been prepared for reproduction in two colours, which method, it is hoped, will commend itself to the public, making, as it does, the maps much clearer and easier to read.

70. The total cost of the party for the year was R92,317 and the cost rates per square mile are:—

	R	a.	p.
For triangulation	14	15	0
For topography	31	13	2

71. The programme for next season is as follows: —

The triangulation of the eastern halves of sheets Nos. 261 to 263 and, if possible, of sheets Nos. 255 and 256.

The survey of sheet No. 257 will be completed, and the remainder of the plane-tablers will be employed in sheets Nos. 401 and 402, which are urgently required for the railway authorities; elsewhere they will be combined, as in the season under report, with those of No. 21 Party, there not being at present sufficient triangulation in advance for them all to be employed within the limits of the area specially told off to the party.

72. The recess office was inspected by the Surveyor-General in September who was satisfied with the general state of the party and the progress made, considering that this was its first season in Burma. The Mahrátta Brahmins, of whom there were several in the party, were unable to cope with the difficulties, and they more or less gave in and either shirked their work or took sick leave. Steps are being taken to discharge or transfer these unsuitable men, and replace them by natives of Upper India. This, however, cannot be done in a season, and time must be given to allow of new men being trained at the Dehra school, which is doing good work, but should be largely increased. To do this without some addition to the Great Trigonometrical office building is impossible, but in the present state of the finances, this appears to be out of the question, and efforts will be made to do the best possible without such additional expenditure.*

* Of the European assistants, Messrs. Hall and Serrao are worthy of special mention. The Native assistants did not do well, but it is hoped that during this next field season a marked improvement will be seen.

UPPER BURMA.

No. 11 Party.

73. Again this year Captain Renny-Tailyour, R.E., held charge of this party, the bulk of which continued the 1-inch survey of the Southern Shan States, whilst two detachments were sent, the one under Lieutenant Coldstream, R.E., to survey part of the Chin hills and the other under Surveyor Mahmud Husain to survey the boundaries in Karenni. Lieutenant Coldstream's report will be found in the Appendix.

Personnel.

Captain T. F. B. Renny-Tailyour, R.E., Deputy Superintendent, 1st grade, in charge.
Lieutenant W. M. Coldstream, R.E., Officiating Deputy Superintendent, 2nd grade.
Mr. P. J. W. Doran, Extra Assistant Superintendent, 4th grade.
" W. M. Kelly, " " 5th grade.
" P. White, " " 6th grade.
" H. G. Shaw, Sub-Assistant Superintendent, 1st grade.
" H. H. B. Hanby, " " 2nd grade.

Surveyors and Sub-Surveyors.

Mahmud Husain, J. Sebastian, Ramsabad, Abdul Rahim, Kudratullah, Mowni Ram, Ram Pershad, Ali Husain, and 11 Probationary and Apprentice Sub-Surveyors.

74. The general plan of detail operations on the 1-inch scale was to survey sheets Nos. 316 and 407 and portions of sheets Nos. 362 and 406; owing however to the difficulty of the country in sheet No. 407, it was found impracticable to commence sheet No. 406. Triangulation in advance for next season's plane-tabling was carried on over sheets Nos. 403, 404 and 405.

75. The majority of the party left Bangalore on the 28th October and embarked at Madras for Rangoon on the 29th idem; at Rangoon the men to whom departmental leave had been granted, and the *khalásis* joined the party, and the whole proceeded by rail to Thazi and by road to Fort Stedman, where the field head-quarters was formed. Most of the surveyors started thence to their work on the 25th November.

76. The outturn of work is as follows:—

	Square miles.
Triangulation for the 1-inch survey	3,220
" " ¼ " "	2,000
Topography on the 1 " scale (including 454 square miles of overlap and riverain survey)	1,649
Geographical survey ¼ " "	8,170

The area surveyed on the 1-inch scale would have been considerably increased had it not been that four of the best surveyors were otherwise employed, and none of the new hands were able at the commencement of the season to do independent work in such difficult country; at the same time the preliminary training given to those apprentice sub-surveyors, who had gone through a course at the school at Dehra Dún, was found to be a most valuable assistance. This is the first season these trained apprentices have been tried and the experiment so far has proved successful. The results of the expedition into the Chin hills by Lieutenant Coldstream and his three surveyors were an area of 8,170 square miles on the ¼-inch scale, a good outturn considering the difficulties they had to contend with. Lieutenant Coldstream deserves much credit for the success of his work in the Chin hills.

77. The country surveyed in the Shan States is hilly, the ranges and valleys running more or less north and south. The hills as a rule are covered with tree jungle and the valleys, though open in places, are mostly covered with small tree or scrub jungle. A great peculiarity of the country is the number of hollows or devil's cauldrons into which a great deal of the drainage flows and disappears, making its way presumably into the larger rivers flowing at a lower level, though of this there is no outward sign.

78. The health of the party was on the whole excellent. As usual there were cases of fever on the road both going and coming, but the exceptionally dry season was in their favour.

79. The party returned to Fort Stedman during the last week in April 1897, and proceeded to recess quarters at Bangalore where the office was opened on the 25th May. During the recess all the triangulation was computed and the 1-inch mapping brought up to date, with the exception of the hill shading of sheet No. 316 which will be finished in the Calcutta Drawing Office, and of sheet No. 407, a small area in which will have to be resurveyed. The ¼-inch

survey in the Chin hills was incorporated in sheets Nos. 2 N.E., N.W., S.E., S.W., and a special boundary map of part of Karenni was drawn.

The programme for the ensuing season comprises the detail survey of sheets Nos. 403 to 406 and triangulation in advance will be carried on in sheets Nos. 310, 311, 356 and 357.

In addition to the above it is probable that Captain Renny-Tailyour and three surveyors will be detached to accompany the China Boundary Commission.*

UPPER BURMA.

No. 21 PARTY.

80. Major Longe continued to hold charge of this party until the 9th April 1897, when he left the field to take up the duties of Assistant Surveyor-General at the Head-Quarters Office in Calcutta; the direction then devolved on Captain A. J. Pilcher who took over charge from the 15th idem and held it till the end of the year.

Personnel.

Major F. B. Longe, R.E., Superintendent, 2nd grade, in charge up to 9th April.
Captain A. J. Pilcher, R.E., Officiating Deputy Superintendent, 2nd grade, in charge from 15th April to close of the year.
Mr. A. J. Wilson, Extra Assistant Superintendent, 1st grade, up to 17th June 1897.
" A. J. James, " " " 3rd "
" J. M. Kennedy, " " " 6th " on deputation in Siam up to 28th June 1897.
" W. F. E. Adams, Sub-Assistant Superintendent, 1st grade.
" P. R. Anderson, Probationary Sub-Assistant Superintendent, 3rd grade.

Surveyors and Sub-Surveyors.

Ikbaludin, Lachman D. Jadow, Ganu Mall, Mahomed Latif, Natha Singh, Budhi Bulram, Jamna Pershad, and ten probationary and apprentice sub-surveyors.

81. The party left recess quarters at Bangalore during the first week of November and proceeded to Nammaw in Hsi Paw State where field head-quarters were established.

82. The operations of the season comprised:—

(1) The continuation of the 1-inch topographical survey of the Shan States.
(2) The 1-inch survey of a small area round Nanyatseik in the neighbourhood of the Jade mines.
(3) The filling in and revision of certain areas in the same district on the ¼-inch scale.
(4) One sub-surveyor was told off to accompany the Superintendent, Northern Shan States, on tour along the China frontier.

83. Owing to the fact that No. 10 Party was employed in the same district, the three European assistants of this party had to be employed supplementing and extending the triangulation, working out their computations in the field. Mr. Anderson, who only joined the department in November, was first instructed in and then took up detail survey.

Lachman Jadow and an apprentice were detached to carry out the second and third portions of the programme, while Natha Singh accompanied the Superintendent, Northern Shan States, after having surveyed a small area on the 1-inch scale in Hsi Paw.

84. The areas completed are as follows:—

	Square miles.
Triangulation	2,967
Topography on 1-inch scale (including 277 square miles of overlap)	2,137
" on ¼-inch "	3,548

85. The country surveyed, which included parts of Hsi Paw, Tawng Peng and Lawk Sawk States and of the Mandalay district, was as in previous years intricate and difficult, being very hilly and generally covered with thick jungle and almost impenetrable grass. Hsi Paw town fell within the area, but beyond this, which is of importance as being the residence of the Hsabwa, no town of any note was met with.

*The officer in charge reports that as usual Mr. Doran did his work in a very satisfactory manner, that Messrs. Kelly, White and Shaw have also done well, and that Mr. Hanby promises to turn out a useful assistant. In the subordinate staff the majority have done well, Surveyors Mahmud Husain and J. Sebastian being specially mentioned.

The country surveyed round Nanyatseik was particularly intricate, and the survey was specially undertaken on account of the value of the land as being productive of rubies, and the many disputes consequently arising. The undergrowth in this area was very dense.

86. The total cost of the party for the year was R89,383, and the cost rates per square mile are as follows:—

	R	a.	p.
Triangulation	10	8	3
Detail survey on the 1-inch scale	21	5	4
" " ½-inch "	3	8	9

These rates are lower than in previous years, which is satisfactory.

87. The surveyors were visited and their work was examined in the field by Major Longe and Mr. James of No. 21 Party and also by Mr. Cusson of No. 10 Party and was found on the whole to be good.

88. Field work ceased about May 10th and the party returned to recess quarters from Rangoon by the steamer of the 23rd idem, the recess office being opened at Bangalore on June 3rd.

89. During the recess the whole of the computations have been completed, and the following standard sheets have been drawn for reproduction in two colours, the hill shading being in brown, *viz.*, standard sheets 305, 351, 352, 353 and half of sheet 260.

90. The programme for next season is as follows:—

Major Longe with a small detachment will accompany the Burma-China boundary delimitation commission.

The detail survey of sheets 398, 399, 400 will be completed, and endeavours will be made to survey sheet 397, while sheets 395, 396 and 397 will be triangulated.

91. Towards the close of the year, the party lost the services of Mr. A. J. Wilson, Extra Assistant Superintendent, 1st grade, who after a long and honourable career in the department was superannuated on the 1st September 1897.

92. The recess office was inspected by the Surveyor-General at Bangalore in September, and he expressed his satisfaction with all he saw.*

SIND.

No. 12 Party.

93. The operations during the year under report were in continuation of those of the previous season. Captain Hodgson held charge of the party throughout the season.

Personnel.

Captain G. B. Hodgson, I.S.C., Superintendent, 2nd grade, in charge.
Mr. R. C. D. Ewing, Extra Assistant Superintendent, 4th grade.
" G. G. Vander-Beek, Extra Assistant Superintendent, 5th grade.
" R. F. Warwick, Extra Assistant Superintendent, 6th grade.
" J. Smith, Sub-Assistant Superintendent, 1st grade.
" F. P. Walsh, " " 1st grade.
Babu S. C. Sen, " " 2nd grade.
Munshi Rahmatulla, " " 2nd grade.
Mr. E. C. J. Bond, " " 3rd grade.
42 Permanent and temporary Sub-Surveyors, Computers and Draftsmen.

94. The programme which was completed was as follows:—

(*a*) Two series of secondary triangulation, each about 90 miles in length as a check on the traversing.

(*b*) The completion of the village boundary traverse survey commenced last season in sheets Nos. 47, 48, 49, 66, 67, 68, 69, 87, 88, 89, 90, 109 and 110 from the Indus river on the west to the desert on the east.

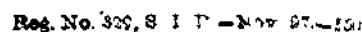
* The officer in charge reports that Mr. James has again proved himself a hard-working and trustworthy assistant, and that Mr. Anderson is a promising assistant. Among the native staff Surveyor Lachman Jadow and Sub-Surveyors Ganu Mall, Natha Sing, Budhi Bulram and Jamna Pershad are deserving of special mention.

SIND SURVEY.

1896-97. **No. 12 PARTY.**

Divisions	Districts	Chief Towns
SIND	Hyderabad	Hyderabad
	Upper Sind Frontier	Jacobabad
	Shikarpur	Shikarpur
	Thar and Parkar	Umarkot
	Kurrachee	Kurrachee
NATIVE STATE	Khairpur	Khairpur

Scale of Miles.



Reg. No. 320, S. I. P.—Nov. 97.—150 Photo. S. I. O., Calcutta.

REFERENCES to COLOR.

Surveyed in previous Seasons Scale 1″ = 1 Mile

...Do.............do..............2″ = 1 Mile

....Do........1896 97..........Scale 2″ = 1 Mile

Triangulated & Traversed in advance

Surveyed on 1″ = 1 Mile by No. 15 Party, 1896-97

Triangulated by No. 15 Party, 1896-97

No. 454-S. 97.

NOTES.

The numerals **63**, &c., indicate the Standard sheets on the Scale 1 Inch = 1 Mile.

The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas.

(c) The detail survey on the 2-inch scale of an area between the same limits in sheets Nos. 47, 66, 67, 87 and 88; the cultivated portion of sheet No. 32 and the completion of sheet No. 33, of which a little more than half was surveyed the previous season.

95. The recess office at Kurrachee closed on the 20th October 1896, and the party reassembled at Hyderábád on the 25th idem, and each man was on his ground by about the end of the first week of November.

96. As sufficient area was not traversed in advance in the sheets of which the detail survey was to be taken up, a large part of the area surveyed in detail was also traversed this season.

97. The season's triangulation was to serve as a check on the traverse survey and was done by Messrs. Vander-Beek and Smith. The former completed the series he commenced last season, emanating from the side Khánatar H.S.—Thumi S. of the Sehwán secondary series a little to the north-west of Sángl ar and closing on the side Rakhrái H.S.—Nága Sha T.S. of the Kurrachee longitudinal series to the south-west of Hyderábád. Throughout its length this series passes across a perfectly flat country with here and there large patches of *tamarisk* jungle and groves of *bábul* trees. In order to extend the view of the surveyor, a trestle 15 feet in height was obtained for this work, but it was never used as the high banks of the numerous canals, formed by the original excavations and the annual clearance of silt, were found to afford sufficiently raised positions for the stations, to observe over short distances. The portion of this series which falls in sheet No. 67 was carried out while the detail survey was in progress; consequently the stations were not utilised by the plane-tablers and do not appear on the maps. They were marked by bricks, one mark on the surface of the ground and another about 2 feet below it. The other series was commenced from Khárora S. and Mánuro S. of the Sehwán secondary series also in the vicinity of Sánghar and closed on Hatodan H.S.—Karúra S. of the Sind meridional series near Umarkot. Very few of the stations were situated on land that will be surveyed at present, as the series was carried along the edge of the desert and the majority of the stations were placed on sand hills. They were marked with bricks also, the lower mark being 3 feet below the surface, but it is doubtful if they will ever be found again owing to the shifting of the sand hills. They have, however, answered their purpose for the present. Lists of the co-ordinates with description of the stations of both these series were sent to the Irrigation Department, so that they might erect marks of a more permanent nature if considered necessary.

98. The traversing consists of a village boundary survey with offsets, and the area traversed is 3,635 square miles, of which 890 square miles have been surveyed in detail, leaving 2,745 traversed in advance. There were 6¾ main circuits measured, 29 sub-circuits and 660 villages. The angular work was checked by observations for azimuth at 110 stations on main and sub-circuits, and the average angular error is 3·1 seconds. The linear measurements amounted to 3,477 miles, and were checked by 13 connections with stations of the secondary triangulation executed during the season. The average correction per 1,000 links is 0·9 links. No permanent marks were put down at traverse stations, but the stones used by the Sind Revenue Survey to demarcate the field boundaries were utilised wherever possible, and the positions of all marks on the village boundaries have been fixed by offsets.

99. The cost of the traverse survey is Rs. 33,040, giving a cost rate of Rs. 9·1 per square mile. This is nearly half the cost of the same work done during the previous season, which is mainly due to the fact that last season was the first of the survey, and all the expenses of the transfer from Upper Burma fell into it. The average size of the villages is 5·5 square miles.

100. In addition to the boundary survey, 128 bench-marks of the Irrigation Department—chiefly on embankments and canal banks—and 15 of the Kotri-Rohri branch of the North-Western Railway were connected with the traversing, involving additional observations at 864 stations, and 204·5 linear miles of chain measurements. The cost is included in the figures given above.

101. The area surveyed in detail on the 2-inch scale amounts to 2,244 square miles and was mapped on 52 plane-table sections. It comprises portions of sheets Nos. 32, 33, 47, 65, 68, 87 and 88 and the whole of Nos. 66 and

67. In sheets Nos. 87 and 88, the survey has been carried to the edge of the desert. Sheet No. 47 has been surveyed up to the work of the Indus Riverain survey of a few years back. The remainder of the sheet will be surveyed. on the 1-inch scale by No. 15 Party. In sheet No. 32 the cultivated portion only has been surveyed, and the remainder of this sheet also will be surveyed by No. 15 Party on the 1-inch scale. Only a small portion of sheet No. 65 was surveyed to include the head works of the Jamrao Canal at present under construction. The rest of the sheet will not be surveyed for 3 or 4 years to come. Sheet No. 33 was partially surveyed by this party last season and partially by the Indus Riverain survey previously. It has now been completed. The detail survey was carried out almost entirely by interpolation and was based mainly on the traversing. It was tested from 1,072 *in situ* fixings in addition to 33·7 linear miles of check lines, and was done under the direct supervision of the officer in charge and 3 assistants, of whom two were employed on plane-tabling as well.

102. The cost of the 2-inch detail survey is Rs. 14·2 per square mile. This is considerably less than the same work cost last season as was anticipated, *vide* paragraph 95 of last year's report.

103. The character of the country topographically surveyed varied considerably and a good deal of it was somewhat intricate, though, with the exception of a few sand hills here and there, the whole of it was absolutely flat. To the east along the banks of the Nára river it was largely covered with scrub jungle and sparsely populated. To the west of this, in the tract watered by the Mithrao canal the land was well populated, highly cultivated, and contained a great deal of timber, while further west again, it was mostly of a dry sandy nature and very bare and open, though fairly well populated. This was the character of the greater part of sheets Nos. 66 and 67, though in some places the canals were thickly lined with *bábul* trees. In sheet No. 47 the country was more thickly populated and contained many large villages, with huge clumps of *bábul* trees which also lined the canal banks as a rule. The weather was very favourable for survey operations throughout the field season. There was a remarkable absence of wind and dust which were such prominent features in the weather of the previous season. There was little or no sickness at all.

104. Field work closed about the middle of April and, on account of the plague which was then raging at Kurrachee, the party proceeded to Mussooree for the recess. During recess the fair mapping was completed of almost the entire area surveyed in detail. The portion not fair drawn lay in sheets Nos. 65 and 68, in both of which only a small area was surveyed. It is not proposed to draw sheet No. 65 until the survey of the sheet is completed. If required by the Irrigation Department, a trace of the field sheets will be furnished. Sheet No. 68 will be drawn next season when the survey will be completed. The mapping was comprised in 28 quarter sheets, of which 5 were blank. They were drawn on the 2-inch scale for reduction by photography to one-half and have all been despatched to the Trigonometrical Branch Office at Dehra Dún for publication. Sheet No. 32 has been drawn as far as surveyed. The remainder of the sheet will be mapped by No. 15 Party. Sheet No. 33 contains a small area that was surveyed on the 1-inch scale in the course of the Indus Riverain survey, and this will be incorporated with the work of the present survey in the Dehra Office. Sheets Nos. 66 and 67 were mapped in full, but in sheet No. 47 again, some 1-inch work of the Indus Riverain survey has to be incorporated and the western half will be mapped by No. 15 Party. Sheets Nos. 87 and 88 have been mapped as far as they are to be surveyed at present and will be published.

105. The fair maps of the previous season, which had been detained, pending instructions from the local authorities regarding doubtful *gote* names, were completed this season and despatched to the Great Trigonometrical office at Dehra. The names of *gotes* or hamlets which differed from those given in the settlement maps, or did not appear in them at all, were again submitted to the District Officers, who notified the correct names and whether they were temporary or permanent. All those said to be temporary were omitted from the fair maps.

106. The village boundaries were also roughly compared with the settlement maps and in the cultivated parts they generally agreed sufficiently well to make it clear that the correct boundary had been followed by the traverse surveyor, but in jungle lands away from habitations, the marks were often not

to be found and no one could point out the boundary correctly. In such cases the boundary on the fair maps has been taken from the settlement map.

107. The triangulation and traverse charts of sheets Nos. 47, 48, 66, 67, 68, 87, 88, 89, 108 and 109 have been drawn, and a general report in two volumes has been compiled for each of the two series of triangulation. The charts of sheets Nos. 15, 16, 17, 32, 33 and 35 comprising the whole of last season's triangulation and traversing have also been completed, and one general report in two volumes has been compiled for all these sheets. All the charts with lists of co-ordinates and village or *deh* names have been despatched to Dehra, but none of the general reports have yet been submitted as the binding was not quite completed. The charts of sheets Nos. 65, 69, 90, 109 and 110 have not yet been prepared. In sheet No. 65 only a small area was triangulated and in the other sheets small areas still remain to be traversed.

108. The survey of the Layári quarter of Kurrachee on the scale of 80 feet to the inch which was commenced last recess season was completed this season shortly after the party took the field. The area is 899 acres and the survey is based on a theodolite traverse survey by which the area was divided into 40 blocks. The traversing is connected with two G. T. stations of the Great Indus series. The chaining amounted to 18·7 linear miles and the theodolite was set up at 331 stations. The detail survey was carried out by blocks on 30 plane-table sections and not in rectangular sheets, and was tested by 51,088 feet of check lines run by Captain Hodgson and Mr. Smith. The boundaries of holdings were defined and a record made of the tenants or occupiers. The fair maps have been drawn in 18 rectangular sheets and have been despatched to Dehra for reproduction by photozincography. Printed copies will be supplied to the Municipality. The boundaries of the holdings have not been marked off on the fair maps; they will be defined by a ribbon of colour on the printed copies. The fair copy of the record is almost completed. The cost of this survey, to which no share of general charges has been added, amounts to Rs. 3,951, which is divided into the following items:—

	Rs.
(*a*) Traverse and detail survey, including the record . .	1,456
(*b*) Mapping and fair copy of the record	2,495
TOTAL .	3,951

The cost rate of the whole survey, including fair mapping and a fair copy of the record, is Rs. 4·4 per acre and of the field work alone is Rs. 1·6 per acre. There will be a further small expenditure in colouring up, on the printed maps, the boundaries of the holdings or numbers and in completing the record.

The original estimate amounted to Rs. 1,069 but did not include the record nor any charges for supervision, and no charges for the latter item have been added for the field work, which was supervised by Mr. Smith in addition to his other duties, but as the whole of his time was taken up in looking after the fair mapping during the recess, the charge has been added for that period.

109. Next season no triangulation will be done, as the area to be traversed is crossed by the Kurrachee Longitudinal Series of the Great Trigonometrical survey, which will provide a sufficient check on the traversing. The sheets that will be traversed are Nos. 50 and 51 (to the east of the Indus and in continuation of the work of the Indus Riverain survey); the whole of Nos. 70, 71, and 91 and portions of Nos. 92 and 111 up to the edge of the desert—the whole amounting to 2,700 square miles approximately. About 2,800 square miles will be surveyed in detail on the 2-inch scale, covering slightly more than the area already traversed in advance in sheets Nos. 48, 49, 68, 69, 89, 90, 109 and 110.

In addition to the ordinary programme, an area of about 1,500 square miles of the lands watered by the Desert canal in Kalát territory adjoining the Shikárpur district will be prepared for detail survey and about 600 square miles surveyed on the 2-inch scale in connection with a contour survey to be carried out by the Irrigation Department.*

* Of his assistants Captain Hodgson reports that Mr. Ewing is an excellent Head Assistant, and that all the others have worked well this season. Of the Subordinate Establishment he particularly mentions Sub-Surveyors Mukund Dinkar, Irfán Ali, Maksúd Ali, Muhammad Akbar, Muhammad Azam, Khair Uddin, Ishar Singh, Abdul Aziz, II, Lál Bihári Lál, and Ghulám Husen; Computers Narsu Dinkar and Laxman Daji, and Draftsman Makbúl Husen. Sub-Surveyor Maula Bakhsh was on deputation to the settlement office at Dera Gházi Khán throughout the field season and did good service during the recess.

BALUCHISTAN.

No. 15 Party.

110. The following changes occurred in the superintendence of this party during the year. From the 1st October to the 1st November 1896 Mr. Claudius continued in charge. From the 2nd November to the 2nd of April Captain H. A. D. Fraser, R.E., held charge. Finally, from the 3rd April Colonel Sir T. H. Holdich resumed charge.

Personnel.

Colonel Sir T. H. Holdich, K.C.I.E., C. B., R.E., Superintendent, 1st grade
Captain H. A. D. Fraser, R.E., Deputy Superintendent, 2nd grade.
Lieut. F. W. Pirrie, I.S.C., Officiating Deputy Superintendent, 2nd grade.
Mr. T. E. M. Claudius, Extra Assistant Superintendent, 1st grade.
Mr. E. A. Wainright, „ „ 4th grade.
Mr. G. A. Knight, „ „ 6th grade.
Mr. G. P. Tate, „ „ 6th grade.
Yusuf Sharif, Khan Bahadur, Sub-Assistant Superintendent, 1st grade.
Hira Singh, Rai Bahadur, „ „ 1st grade.
Imam Sharif, Khan Bahadur, „ „ 2nd grade.
Mr. H. C. H. Cooper, „ „ 3rd grade.
Ahmed Ali Khan Bahadur, „ „ 3rd grade.

Surveyors and Sub-Surveyors.

Hussain Bux, Khan Sahib.
Sheik Mohiudin, Khan Bahadur.
Asgar Ali Beg, Khan Bahadur.
Jafar Ali.
Gopal Singh, Rai Bahadur, and 20 others.

111. During the field season the head-quarters of the party under Captain Fraser were located at Mooltan. The traverse work for the 2-inch survey was started early in November and this, with all the plane-tabling comprising 932 square miles, was completed by the end of March of the following year.

Lieutenant Pirrie undertook the triangulation for 1-inch survey in Sind and also superintended and checked the topography of his squad; Lieutenant Pirrie with a squad of 5 native surveyors was ordered to join the Tochi Field Force in June.

Mr. Tate with the assistance of surveyor Khan Bahadur Asgar Ali Beg was left at Quetta during the winter months to complete the fair drawing of all the work done during the demarcation of the Balúch-Afghán Boundary Commission.

The services of Khan Bahadur Imam Sharif were asked for by the Government of Zanzibar for the survey of that island. He accordingly left India for this duty on the 5th March 1897.

112. The total outturn of the party is as follows:—

	Square miles.
Triangulation for 1 inch survey	1,620
Ditto 6-inch do.	260
Ditto 12-inch do.	60
TOTAL	1,940

	Linear miles.
Traversing for 16-inch survey	802
Ditto 2-inch do.	735
TOTAL	1,537

	Square miles.
Topographical survey 1-inch	1,825
Ditto do. 2-inch	912
Ditto do. 6-inch	21
Ditto do. 12-inch	56
TOTAL	2,814

PUNJAB SURVEY

1896-97

INDEX TO THE SURVEY OPERATIONS IN THE HIMALAYAS

NO. 18 PARTY.

KASHMIR

CHAMBA

KANGRA

KULU

LAHUL

BASHAHR

JULLUNDUR DISTRICT

HOSHIARPUR DISTRICT

GURDASPUR DISTRICT

AMRITSAR DISTRICT

UMBALLA DISTRICT

SAHARANPUR DISTRICT

JUMMOO

DALHOUSIE

CHAMBA

BARA BANGAHAL

GURDASPUR

HOSHIARPUR

KOTGARH

SIMLA

UMBALLA

DEHRA DUN

84 N.W.

84 S.W.

85

88 N.W.

88 S.W.

REFERENCES.

	1" = 1 Mile	4" = 1 Mile	2" = 1 Mile
Surveyed during previous Seasons			
Do. 1896-97			
Area Triangulated in advance			
Do. 1896-97			
Simla-Kulu Road Survey, published on Scale 8 Inches = 1 Mile			
Approximate limit of Snow tracts			

NOTES.

The figures and lines in strokes represent the numbers and limits of the Engraved sheets of the Indian Atlas.

The subscripts 246, &c., indicate the Standard sheets.

Scale of Miles

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dun.

No. 135-S. 97.

113. During the recess all the computations in connection with the season's triangulation and traverse work have been revised and completed. Four General Reports with their respective fair charts were near completion, but had to be left unfinished on account of a number of assistants being called away for the Tochi and other frontier expeditions.

The head-quarters will be located at Quetta during winter and a drawing section kept up.*

HIMALAYAS, PUNJAB.

No. 18 Party.

114. Mr. C. D. Potter was in charge of this Party at the commencement of the year under report, but was relieved by Captain C. L. Robertson, R.E., on the 12th November 1896, who remained in charge till 5th August 1897, when he was ordered to join the Malakand Field Force. Mr. C. D. Potter again held charge until the 20th August, when he was relieved by Mr. L. J. Pocock, who held it till the end of the year.

Personnel.

Captain C. L. Robertson, R. E., Officiating Deputy Superintendent, 2nd grade, in charge from 12th November 1896 up to 5th August 1897.
Mr. L. J. Pocock, Extra Assistant Superintendent, 1st grade, in charge from 20th August 1897.
" C. D. Potter, Extra Assistant Superintendent, 4th grade, in charge from 1st October to 11th November 1896, and from 6th up to 19th August 1897.
" W. Robert, Extra Assistant Superintendent, 5th grade.
" W. A. Fielding, " " " 6th "
" W. M. Gorman, Sub-Assistant Superintendent, 2nd grade.
" E. J. Biggie, " " 3rd "
" C. E. C. French, " " 3rd "

Surveyors and Sub-Surveyors.

Shah Nasiruddin, Ram Saran, Asmatullah Khan, Dalbir Rai, Amir Singh and 27 others.

115. The work of the party, as in former years, comprised the topography of British tracts on the 4-inch scale; of the Native States on the 2-inch scale; and of all demarcated forests, wherever situated, on the 4-inch scale.

116. The localities that were under survey were :—

(i) The Kángra district and Kúlu sub-division of that district, on the 4-inch scale.
(ii) The Native States of Mandi, Suket, Sirmúr and Simla Hill States, on the 2-inch scale.
(iii) Special surveys of the forests of the Patiála and Sirmúr Native States and revision of a portion in Kalsia State, on the 4-inch scale.
(iv) Triangulation in advance of topography in the Kángra district, and in Biláspur of the Simla Hill States.
(v) The classification of forest growth and soils *pari passu* with the topography in British tracts, and special forest surveys.
(vi) The large scale survey, 48-inches = 1 mile, of the town of Náhan in Sirmúr, carried out at the special request and cost of the Sirmúr State.

117. All, except the last, of the above operations were in continuation of the previous season's work. The system of classification of forest growth and soils was continued in Kúlu, Patiála, Sirmúr and in Kángra, and local officers, as before, are supplied with ferrotyped reproductions of the field work, in advance of the publication of the 4-inch sheets. Arrangements have now been made by Captain Robertson, in consultation with the Superintendent, Trigonometrical Surveys, for the preparation of these traces of classification once for all in the field, for reproduction, with a view to avoiding in future the necessity of redrawing them on return to recess. This will save a deal of labour and enable copies to be issued much earlier than formerly. This is of considerable importance to Forest Officers who use these traces to help them in their "working plans."

118. The party was divided into four sections or detachments, the head-quarters being in charge of the Executive Officer, and the other three in charge

* The Officer in charge reports that all the members of the party, both European and native, have worked with energy and good-will both in the field and recess.

of Messrs. C. D. Potter, W. Robert, and W. A. Fielding, who supervised squads of 6, 8 and 6 sub-surveyors respectively. These detachments left recess quarters at various dates between the end of August and about the beginning of November, returning to recess quarters during the period between the end of March and the beginning of May.

119. The outturn of the field season's work was as follows :—

(*a*) Triangulation in Kángra 202 square miles.

(*b*) Detailed survey on the 4-inch scale :—

	Square miles.
Kángrà	181·0
Kúlu	152·0
Sirmúr	111·9
Patiála	0·3
Kalsia (revision)	1·0
	446·2

(*c*) Detailed survey on the 2-inch scale : —

Mandi, Suket and Simla Hill States	306·7
Sirmúr State	57·0
	363·7

The surveys of the following forest blocks are included in the areas on the 4-inch scale shown above :—

Localities.	No. of blocks.	Area in square miles.
In Sirmúr, Patiála and Kalsia	39	112·0
" Kúlu	28	55·3
" Kángra	13	23·6
TOTAL	80	190·9

120. The detail survey was tested by the Executive Officer and assistants who constantly visited some one or other of the squads. This embraced the examination of 55 plane-table sections on 134 different occasions. No serious errors were detected, and the work as a rule showed a steady improvement.

121. The triangulation of the season was based on sides of the North-West Himálaya series, Great Trigonometrical Survey, and was carried on in district Kángra and in the Native State of Bilâspur. Some additional work was carried on over an area previously reported as triangulated, in which supplementary points were necessary for the 4-inch detail survey. The numerical results prove that the observations have been skilfully carried out, and that care has been bestowed on the work.

122. The cost rates per square mile of the various operations are as follows :—

	R
Triangulation	29·7
Average of all detail survey, 4-inch	93·3
" " " 2-inch	48·7

The cost of triangulation is in excess of that of the previous season, as it includes the computation of areas and preparation of triangulation charts; also because the ground was prepared for survey on the 4-inch and 2-inch scales, which require more points than for a 1-inch survey, for which scale no triangulation was prepared during the season under report.

The cost of the 4-inch detail work, which is also to be reckoned as the cost of the 4-inch forest surveys, is R93·3 per square mile; this is somewhat higher this year; the cost of the 2-inch work is R48·7 per square mile, which is somewhat less than last year. These items have a tendency to fluctuate year by year, the cost being based on calculations which include several factors, which keep varying from time to time; such as cost of instruments, style of ground,

pay of superintendence and surveyors, all of which being taken into consideration, account for the changes.

123. The completion of instruction of Native Soldier Surveyor students from the Thomason Civil Engineering College for a further two years course in surveying forms one of the duties of this party. One man completed his course in September and has gone with Major W. J. Bythell, R. E., on frontier survey duty. The second man who has been only one year under instruction will remain a year longer. In lieu of the man gone to the frontier a Naik of the 44th Gurkhas has joined the party for further instruction. These men are reported to have shown aptitude for the work and have learnt to use the plane-table and clinometer.

124. With reference to paragraph 125 of last year's report, wherein it is stated that this party rendered professional aid to the Simla Municipality during the recess months in revision surveys, for the bringing up of maps to date, the President has conveyed his best thanks for the excellent manner in which the revised map of Simla has been prepared.

125 The country surveyed in Sirmúr on the 4-inch scale is mostly ground rising to a height of 5,000 feet with bold features, covered with forest except where there are habitations and cultivation. All this admitted of survey by interpolation and so progress was quick. Besides this there were about 30 miles of ground surveyed which fell in low Siwálik hills, covered with miscellaneous forests. The whole of the ground was divided into forest compartments, the surveying of which took up considerable time.

The 2-inch work done in this state is mostly on the watershed of the Giri and Tons rivers, between 2,000 and 7,000 feet above sea level, most of which is under cultivation.

126. The large scale survey of the town of Náhan was also commenced, the necessary theodolite traverses have all been completed and set up, and some of the detail work on the scale of 48 inches to the mile done.

127. In Kúlu proper, the work lay in the Upper Beas valley right up the head waters of that river and included peaks up to 20,000 feet high. In this valley the scenery is exceedingly grand. In one part the river pierces a line of cliffs 400 feet high and only a few feet apart, races down with a deafening roar for three-quarters of a mile, emerging into a gentle fordable stream before uniting with the tumultuous waters of the Beas Kand. The natural limit of forest growth in this country is 12,000 feet high. In this season's work there are 29 glaciers; the largest is two miles in breadth at an altitude of 17,000 feet.

128. The 2-inch work in the Native States of Mandi, Suket, also of Bághal and Kahlúr of the Simla Hill States, was commenced about the end of November. This country lies between the Sutlej river and hills rising up to 11,000 feet. The hills are well-wooded and the valleys cultivated and inhabited throughout. The features in this ground are, as a rule, intricate.

129. In Kángra some of the work in the lower hills at the foot of the Himálayas, including the Beas valley, gave a good deal of trouble owing to the difficulty of getting plane-table fixings by interpolation, the chain having to be freely used, which considerably retarded progress of work. The ground as a rule consisted of low, flat hills covered with forest, with cultivation here and there in the valleys, the streams through which flow between precipitous ravines that necessitate long journeys when getting from one place to another. The intricate nature of the ground combined with much undergrowth added considerably to the labour of the surveyor.

130. The proposed programme for this party for season 1897-98 consists of the continuation of 4-inch topography in Kúlu and Kángra; a small detachment will be employed on 1-inch work in the high ground in Kúlu in anticipation of the survey of Láhul. Topography on the 2-inch scale will also be carried on in Suket, the Simla Hill States and in Sirmúr; the State forests in the latter State will be surveyed on the 4-inch scale as heretofore. The Punjab Government have asked for a special survey of part of the Ghaggar river; the scale and the area are still under discussion. The survey of the town of Náhan on the 48-inch scale will be continued. The above programme has been submitted to the Punjab Government and may be liable to alteration.

131. It may be added that steady progress has been made with the drawing of the fair maps and forwarding of them for publication. Up to date 11 sheets

of the Sirmúr and Patiála work and 3 sheets of Kángra have been sent during the year, and six others are approaching completion.

132. The season's work shows a good outturn and compares favourably with that of previous season.

133. The Executive Officer cordially acknowledges the help received from His Highness of Sirmúr and all District and Forest Officers during the course of the operation.

134. The recess office of the party was inspected by the Surveyor-General in July and by the Superintendent, Trigonometrical Surveys, during 8th June and the following days. Both these officers expressed their appreciation of the efficient state in which they found the party.*

FOREST SURVEYS.

CENTRAL PROVINCES.

No. 14 Party.

135. The party remained under the charge of Mr. C. F. Erskine throughout the year. It took the field at Sihorá, district Jubbulpore, on 1st December 1896, and survey operations were generally commenced in the second week of December. By the beginning of April 1897 the field work in district Damoh was practically finished, but the sections working in districts Biláspur and Sambalpur remained out till the end of April to complete the work required to be done there.

Personnel.

Mr. C. F. Erskine, Offg. Deputy Superintendent, 1st grade, in charge.
" J. Keating, Extra Assistant Superintendent, 6th grade.
" R. Waller—Senior " " 6th "
" B. R. Hughes, Sub-Assistant Superintendent, 1st "
" J. O. Greiff, " " " 2nd "
" M. C. Peters, " " " 2nd "

Surveyors and Sub-Surveyors, etc.

Muhammmad Zakaria, Gurdutt Singh, Karimdad Khan, Ram Singh and 44 others.

136. The season's work consisted of the following:—

(*a*) Completion of detail survey on the scale of 4 inches=1 mile in the Government forests of district Damoh and commencement of this work in the Lormi reserve of district Biláspur.

(*b*) Triangulation in advance of topography in districts Biláspur and Sambalpur.

(*c*) Traversing with theodolite of forest boundaries and fire lines in districts Damoh, Biláspur and Sambalpur.

(*d*) Classification of forest growth and soil of all the area surveyed in detail in districts Damoh and Biláspur.

137. The total area of ground topographically surveyed during the season is 622·7 square miles in district Damoh and 73·9 square miles in district Biláspur, making a total of 696·6 square miles. All the forest survey work in district Damoh has now been completed; but in district Biláspur the detail survey was only commenced this year, and much remains to be done, which, however, has been handed over to the Forest Survey Branch for completion. The work was rigorously tested by the European assistants by 412 linear miles of check lines and by *in situ* fixings, and was generally found to have been carefully and accurately surveyed. The Executive Officer also inspected and tested the work of nearly all the plane-tablers in district Damoh. The outturn of this year's topography exceeds that for last year by 46 square miles. The reason of this excess is that the ground in district Damoh was very easy for survey operations, and bore no resemblance to the difficult and

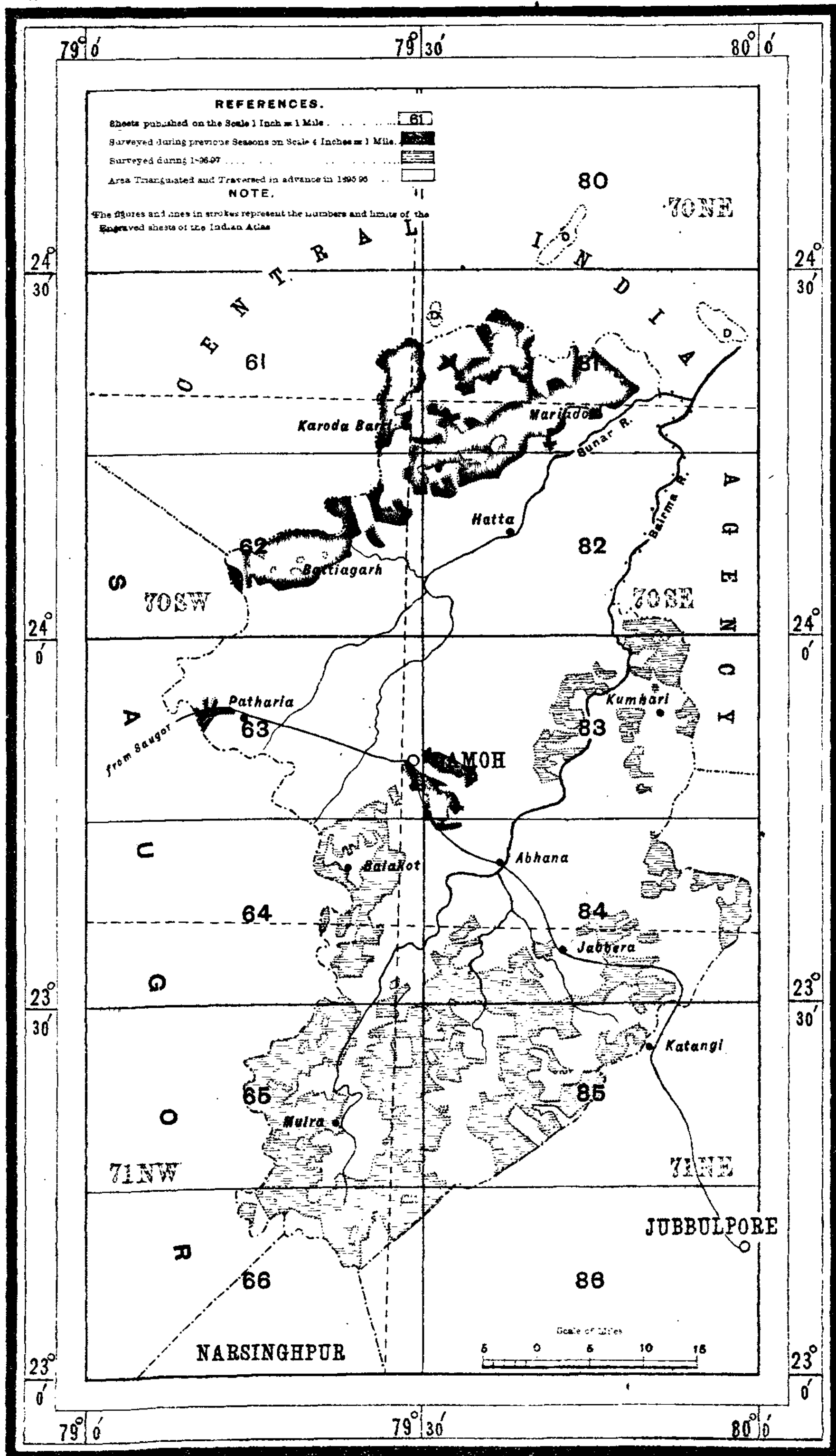
* Mr. L. J. Pocock, who was in charge of the party at the close of the year under report, speaks highly of the services of Messrs. Potter, Robert, and Fielding, who, as heads of their detachments, supervised their establishments most efficiently. Mr. Potter's duties being at times arduous, as besides supervising his detachment, he held executive charge of the party for two short periods. Messrs. Gorman, Biggie, and French have also done well.

Of the subordinate establishment the following are specially mentioned:—

Shah Nasiruddin, Asmatullah Khan, Ram Saran, Garjman Rai, Dalbir Rai, Ram Singh, Narain Dutt, and Amir Singh.

CENTRAL PROVINCES SURVEY.

1896-97. INDEX TO THE FOREST SURVEY IN DIST. DAMOH. No. 14 PARTY.



Reg. No. D. 292, S. I. D. - Oct. 97 - 550

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dun, October 1897.

No. 162 — S. 97.

CENTRAL PROVINCES SURVEY.

INDEX TO THE FOREST SURVEYS IN DISTRICT BILASPUR.

No. 14 PARTY

REFERENCES.

SYMBOLS.

NOTES.

CHOTA NAGPORE

C. I. AGENCY

MANDLA

BALAGHAT

RAIPUR

SAMBALPUR

177 178 179 180 181 182 183

157 158 159 160

136 137

198 199 200 201 202 203 204 205

217 218 219 220 221 222 223

233 234 235 236 237

90 N.E. 90 S.W. 90 S.E. 91 N.W. 91 N.E. 105 S.W. 106 N.W.

Lohari, Amlitahara, Pendra, Mahatin, Amarkantak, Kenda, Uprora, Tartuma, Churi, Korba, Sarhi, Taregaon, Lurmi, Ratanpur, Pandaria, Bija, Bazia, Beria, Betganga, Takatpur, Mungeli, Sendri, Baluda, BILASPUR, Kawardha, Rengakhar, Nawagarh, Bargaon, Agri, Mara, Malhar, Baradwar, Nangar, Seonath River, Seorinarayan, Mahanadi River, Jondhra, Sonanbor, Bilaigarh, Sonakhan

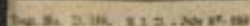
Bengal Nagpur Railway

Scale of Miles

10 5 0 10 20 30

81°0′ 81°30′ 82°0′ 82°30′ 83°0′

23°0′ 22°30′ 22°0′ 21°30′

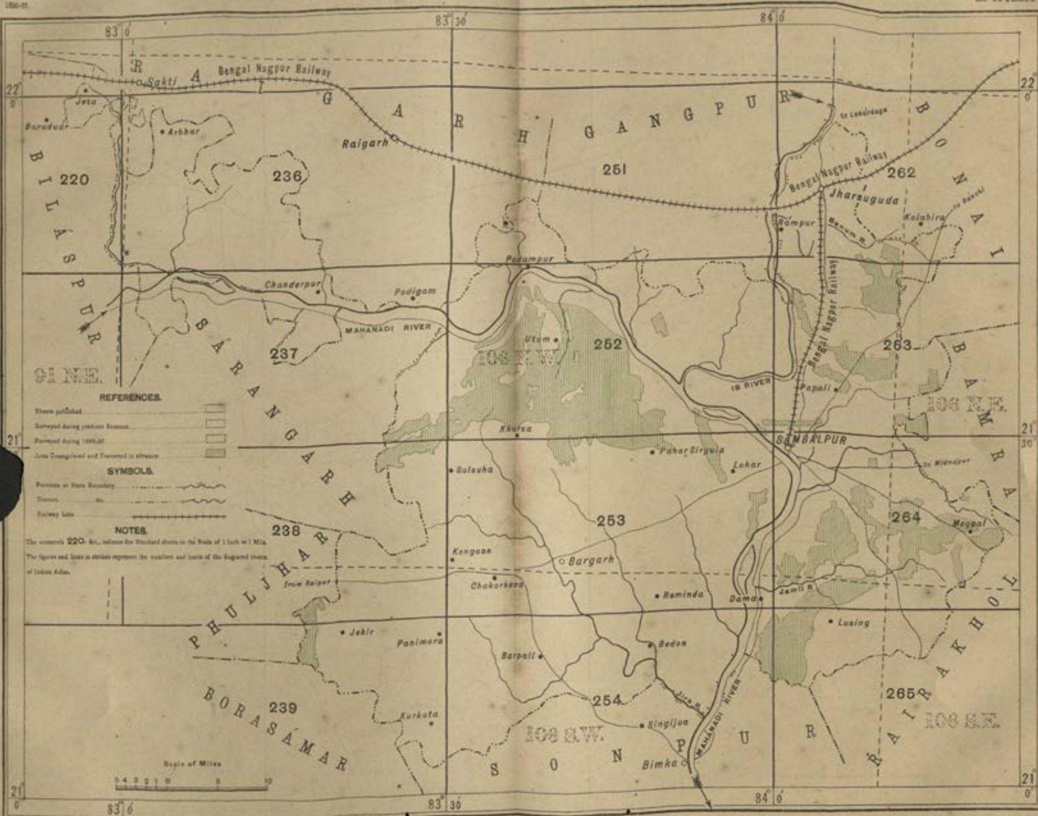


No. 114 - S. 97.

CENTRAL PROVINCES SURVEY.

INDEX TO THE FOREST SURVEYS IN DISTRICT SAMBALPUR.

No. 14 PARTY



No. 137-S. 97.

hilly ground of district Betúl, where the greater portion of last year's topography was carried out.

138. During the field season the boundaries of all the forest blocks surveyed in district Damoh were compared with the settlement boundary traces received from the Deputy Commissioner, to whom all discrepancies were reported.

139. The triangulation in district Bilàspur was carried out in continuation of the same work done last year and covered an area of 666 square miles. But from the scattered nature of the forest blocks this comprises only about 240 square miles of ground for actual topography. The triangulation in district Sambalpur was based on the old triangulation of the East Coast Series. It amounted to 1,104 square miles. The forest blocks in this district are also very much scattered, and hence the above triangulation comprises only about 390 square miles of forest area.

140. The total amount of traversing completed this season is as follows:—

	Linear miles.
District Damoh	10·9
" Bilàspur	226·4
" Sambalpur	78·2
" Betúl (revision work)	1·2

The traversing in district Damoh was run over the boundaries of small *malguzari* patches which were found to exist in the heart of the Government forests and which were not traversed in the previous season.

141. Efforts were made this year to utilize the data of traverses done by Nos. 13 and 9 Parties in districts Bilàspur and Sambalpur. It was found from the old traverse volumes pertaining to the work that most of the boundaries common to Government forests and *malguzari* land in the above two districts were traversed by the survey parties in former years. The old traverse stations were almost all found standing in their positions, which was a matter of considerable importance, and on which the success of the work entirely depended. This party had only to connect the old traverses to the neighbouring trigonometrical points in order to bring the co-ordinates of the traverses to the present origin of survey. Independent traversing of forest boundaries in these two districts has only been carried out by this party, where the boundaries were not previously traversed.

142 The final results of the computations of all the triangulation and traversing done by this party in districts Bilàspur and Sambalpur this year are being handed over to the Forest Survey Branch to be utilized by them when they carry out the detail survey of the ground.

143. The classification of forest growth and soil of all the area surveyed in detail was carried out in the field on separate skeleton traces by the surveyors; the fair maps thereof have been prepared in the recess and supplied in original to the forest officers concerned.

144. The health of the party during the season under report may be said to have remained exceptionally good on the whole. The country in district Damoh, where the bulk of the establishment worked this season, proved to be the most salubrious this party has ever had to survey in the Central Provinces during the past ten years The squads at work in district Bilàspur also kept good health generally. But the small detachment working in district Sambalpur suffered greatly from malarious fever, as the climate of that district is notoriously unhealthy.

145. The fair mapping of the season's topography, consisting of 58 standard sized sections of sheets Nos 63, 64, 65, 66, 83, 84, 85, and 86 in district Damoh and sheet No. 180 in district Bilàspur will be completed before the party goes down to the field.

146. Considerable progress has been made during this year in clearing off the arrears of the general reports of the past ten years' work of this party in the Central Provinces In conformity with the latest orders issued last year on the subject 29 triangulation charts pertaining to the work in districts Hoshangábád, Betúl, Nimár and Damoh have been drawn, and list of points shewn on those charts with their co-ordinates and heights have been prepared. It is hoped there will be no arrears under this head by the time the party closes recess office.

147. The co-ordinates of all the forest boundary pillars especially required by the Forest Department for record in their office have been finally completed.

The above data for district Hoshangábád were out of hand last year; and those pertaining to districts Nimár, Betúl and Damoh have been completed this year and despatched to the Forest Officers concerned; and it is satisfactory to note there are no arrears of this work.

148. Three sepoys were sent to this party in December 1896 for survey training. In the beginning of the field season they were put through a course of plane-tabling on the 4-inch scale, and subsequently were employed on independent work. By the end of March they completed the boards given to them. Their work on being tested was found to have been carefully and accurately performed. In April they were given some lessons in the use of the theodolite, and each did a small piece of traverse which was computed out, and they were made to plot their work from the co-ordinates supplied to them. They were also taught the use of the scales and other survey instruments generally employed in a topographical party. They returned to their regiments on 11th April 1897.

149. The cost rates for each description of work for the current survey year are as follows:—

Triangulation	R	7 4	per square mile against	R	6 8	last year.
Topography	„	70 5	. . .	„	„	81·3	„
Traversing	„	17 7	per linear mile	„	„	13 9	„

150. The increase in the cost rate of traversing this year is due to the fact that a good deal of the men's time was lost in constantly marching from one place to another in order to connect the old traverse work of Nos. 9 and 13 Parties in districts Biláspur and Sambalpur to the trigonometrical points. Besides, corrections had to be applied to all the old computations of the above parties to reduce the co-ordinates to the new survey origin. This necessitated a great deal of office work without any corresponding increase in the field work on which the cost rates have been calculated.

151. Under orders of the Government of India this party has been transferred from the Central Provinces to the Lushai Hills to carry out a topographical survey on the scale of 1 inch = 1 mile. In the coming field season triangulation will be undertaken in the North Lushai Hills and almost all the hands will be employed on this work. But it is proposed to compute out the results of part of the triangulation during the field season to enable the detail survey work to be commenced. Efforts will be made to complete as much topography as possible by the end of the field season.*

BOMBAY PRESIDENCY.

No. 17 Party.

152. Major W. J. Bythell, R.E., held charge of this party throughout the year, with two intermissions; the first from the 1st October to 2nd November 1896, when he was on privilege leave and the next from the 7th September to the end of the season, when he was deputed on service with the Mohmand Field Force as Survey Officer; during both of these periods Mr. C. E. Tapsell held charge.

Personnel.

Major W. J. Bythell, R.E., Deputy Superintendent, 1st grade, in charge.
Mr. C. E. Tapsell. Extra Assistant Superintendent, 3rd grade.
„ S. F. Norman, „ „ „ 6th „
„ C. A. Norman, „ „ „ 6th „

Surveyors and Sub-Surveyors.

Gopal Vishnu (up to 30th June), G. R. Bhopatkar, R. V. Joshi, Govind Gopal, N. V. Bhopatkar, and 39 others.

153. The party continued the survey of forest areas in the three circles of the Bombay Presidency, the season's operations comprising:—

(1) *In the Northern Circle.*—Advance triangulation in the Mándvi *táluka*, Surat district. Detail survey on the 8-inch scale of the teak reserves in the Máhim *táluka*, Thána district.

*Mr. Erskine reports very favourably of all his assistants. The following members of the native establishment are also commended:—

Ram Singh, Mahadeo Daji, Satya Charan Ghosal, Abdul Huq (1), Abbas Ali, Sita Ram, Alay Ahmad (1), Ali Hasan Khan, Baijnath, Anwar Ali, Muhammad Aziz, Alay Ahmad (2), Mahabir, Mohendro Nath Bose, and Syed Razi Hasan. Special mention is made of the services of the head writer, Syed Zille Hasnain.

BOMBAY SURVEY.

1896-97.

INDEX TO THE FOREST SURVEYS IN PORTIONS OF THE NORTHERN, CENTRAL, & SOUTHERN CIRCLES.

No. 17 PARTY.

BOMBAY SURVEY.

INDEX TO THE FOREST SURVEYS IN PORTIONS OF THE NORTHERN & CENTRAL CIRCLES.

1896-97.

No. 17 PARTY.

BROACH

SURAT

N.C.

DHARAMPOR

DAMAN

NASIK

DHULIA

REFERENCES.

Sheets Published on 1" Scale are shown thus ... 125

Surveyed during previous Seasons

Do ... 1896-97 ... on 4" do

Do ... do ... on 2" do

Do ... do ... on 1" do

Area Triangulated in advance

Native States

Forest Circle Boundaries

State ... do

District ... do

Taluka ... do

NOTE.

No. 322-S. 98

BOMBAY SURVEY.

1896-97.

INDEX TO THE FOREST SURVEYS IN PORTION OF THE SOUTHERN CIRCLE

No. 17 PARTY.

73° 74° 75° 76°

16° 15° 14°

37 N.E.
41 N.W.
41 N.E.
41 S.W.
41 S.E.
42 N.W.
42 N.E.
42 S.W.
42 S.E.
58 N.W.
58 S.W.

175 176 207 208 209 210 211 212 241 242 243 244 245 246 247 248 249 249a 273 274 275 276 277 278 279 280 281 282 283 303 304 305 306 307 308 309 310 311 329 330 331 332 333 334 335 336 337 351 352 353 354

AJRA
VADI
BELGAUM
PANJIM
Marmagao
KARWAR
DHARWAR
Ankola
Honawar
Mudhol
Hubli
Gadag
Dambal
Haveri
Hangal
Bankapur
Kalghatgi
Khanapur
Saundatti
Gokak
Chikodi
S. M. RAILWAY

REFERENCES.

Sheets Published on 1" Scale are shown thus 125
Surveyed during previous Seasons
Do. 1896-97 on 4" Scale
Area Triangulated in advance
Native States and Goa
Forest Circle Boundaries
State do
District do
Taluka do

NOTE.

The figures and lines in skeleton represent the numbers & limits of the Engraved sheets of the Indian Atlas

Scale of Miles

10 5 0 10 20 30 40

Photo. S. I. O. Calcutta.

No. 324-S. 98.

(2) *In the Central Circle.*—Completion of detail survey of ordinary forest reserves on the 4-inch scale in the Bhimthádi and Purandhar *tálukas*, Poona district; detail survey on the 8-inch scale of teak reserves and on the 4-inch scale of ordinary forest reserves in the Akola *táluka*, Ahmednagar district; detail survey of *bábul* reserves on the 16-inch scale in the Nevása and Ráhuri *tálukas*, Ahmednagar district; supplementary triangulation in the Akola *táluka* of the Ahmednagar district.

(3) *In the Southern Circle.*—Advance triangulation in the Roha *táluka*, Kolába District. Advance triangulation and traversing in the Kumta, Sirsi, Siddápur and Honávar *tálukas*, North Kánara district; detail survey on the 4-inch scale in portions of the Kárwár, Ankola, Kumta and Sirsi *tálukas* and portions of small areas left unsurveyed in the Yellápur *tálukas*, North Kánara district. In addition to which it was found necessary to add certain boundaries, etc., to work previously done, when the surveyors were unprovided with village maps in the Alíbág *táluka* of the Kolába district.

154. The party left its recess quarters in Poona about the 15th November and closed field operations between the end of May and 10th June, when it returned to Poona.

155. The aggregate outturn for each description of survey for the past and preceding field season is shown in the following statement:—

Description of Survey.	1895-96.			1896-97.		
	4-inch.	8-inch.	16-inch.	4-inch.	8-inch.	16-inch.
Triangulation	280	225	...	1,041	335	...
Traversing	344	...	...	234	10	...
Topography	829	108	15	522	168	33

These figures show a considerable increase in the triangulation for both the 4-inch and 8-inch work, of which 880 square miles were in North Kánara. A small area still remains for traversing in that district. Less traversing was done in Kánara during the last season, as only one man was employed against two that were on that work in 1895-96. For a similar reason the outturn of topography on the 4-inch scale is less, as only one camp under Mr. Tapsell worked in Kánara throughout the season, whereas in 1895-96 Mr. C. Norman's detachment of surveyors was sent to help in the detail survey during the months of March, April and May: this latter detachment was to a great extent employed on the 8-inch and 16-inch scale this year, with the result that there is an increase in the outturn on those scales.

156. The details of the outturn of work done during 1896-97 are as follows:—

1.—*In the Northern Circle.*

	Square miles.
Triangulation, Mándvi *táluka*, Surat district	141·0
Traversing, ditto ditto	10·0
Topography, Máhim *táluka*, Thána district	51·7

2.—*In the Central Circle.*

Triangulation, Ahmednagar district			161·0
Topography, ditto ditto . .	4-inch scale	.	117·8
Ditto, ditto ditto . .	8-inch „	.	96·1
Ditto, ditto ditto . .	16-inch „	.	32·9
Ditto, Poona district . . .	4-inch „	.	16·7
Ditto, ditto . . .	8-inch „	.	5·6

3.—*In the Southern Circle.*

Triangulation, Kolába district	194·0
Ditto, Kánara ditto	880·0
Traversing, ditto ditto	234·0
Topography, ditto ditto	587·5

157. The detail survey was checked by 146·7 linear miles of check lines, as well as by *in situ* fixings whilst the work was in progress.

158. The cost rates per square mile, as compared with those of 1894-95 and 1895-96, are shown in the following table:—

Description of Work	Cost-rates per square mile.			
	Scale.	1894-95.	1895-96.	1896-97.
		R	R	R
Triangulation	4 inch	8·8	7·1	9·5
	8 „	15·0	3·5	5·3
Traversing	4 „	29·5	12·3	11·3
	8 „	4·8	...	4·8
Topography	4 „	81·0	66·8	77·6
	8 „	139·5	122·5	135·7
	16 „	116·5	130·0	156·0

The increase in the cost rates of the triangulation of the 4-inch scale was due to the fact of European agency being employed on it. The Surveyor-General on the occasion of his late inspection of the office has commented on this and given instructions that, whenever possible, native agency is to be employed.

The cost rates of traversing have been considerably reduced owing to greater experience having been acquired by the surveyors in that branch of the work.

The above table shows an increase in the cost rates for topography over 1895-96, but compares favourably with those for 1894-95 and previous years, with the exception of the 16 inch scale; the only apparent reason for this being the employment of very slow and inexperienced hands throughout the season on that class of survey which was unavoidable, as the more experienced surveyors were needed for the 4-inch and 8-inch scales where the hilly nature of the country necessitated their employment. Regarding the 4-inch and 8-inch scales, it is to be noted that the cost rates for 1895-96 had reached a minimum in consequence of the cost for supervision being reduced by a very considerable amount due to the then Superintendent, Lieutenant-Colonel J. R. Hobday, being compelled, through ill health, to go on furlough and Mr. Tapsell acting for him, in addition to his own duties.

159. During the recess the fair mapping and computations of the season's work have been completed, with the exception of some of the computations, the results of which will not be required for immediate use. In the Northern Circle, 18 sections on the 8-inch scale in Máhim *táluka*, Thána district, have been drawn.

In the Central Circle, 39 sections on the 8-inch scale in Akola *táluka*, Ahmednagar district, and 27 sections on the 16-inch scale (*bábul* reserves) in the Ahmednagar district have been drawn.

In the Southern Circle 25 sections have been drawn and the arrears brought up in the Kánara district. Twelve sections of the Kolába district, scale 8″ = 1 mile, have also been prepared for publication.

160. The health of the party was good throughout the season in the Northern and Central Circles, but in the Kánara district there was much fever and dysentery, especially during the months of April and May, due chiefly to the want of water, the wells, pools and springs having in a great measure run dry.

161. The programme for the ensuing field season is as follows:—

Northern Circle.—Advance triangulation in Dáhánu *táluka*, sheet No. 135. Completion of 8-inch detail in Máhim *táluka* in sheets Nos. 135 and 136.

Central Circle.—Advance triangulation in Igatpuri and detail survey on 8-inch scale in the same *táluka*. Continuation of detail survey on 16-inch scale of *bábul* reserves along the banks of the Godávari.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE TRICHINOPOLY DISTRICT.

1896-97. No. 9 PARTY.

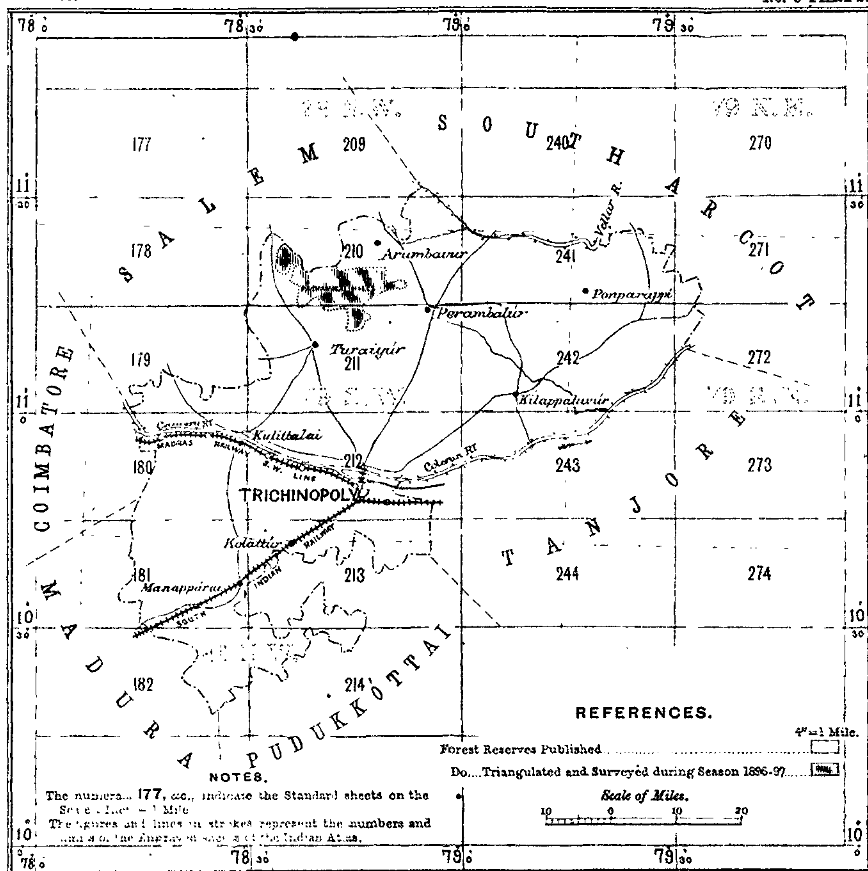
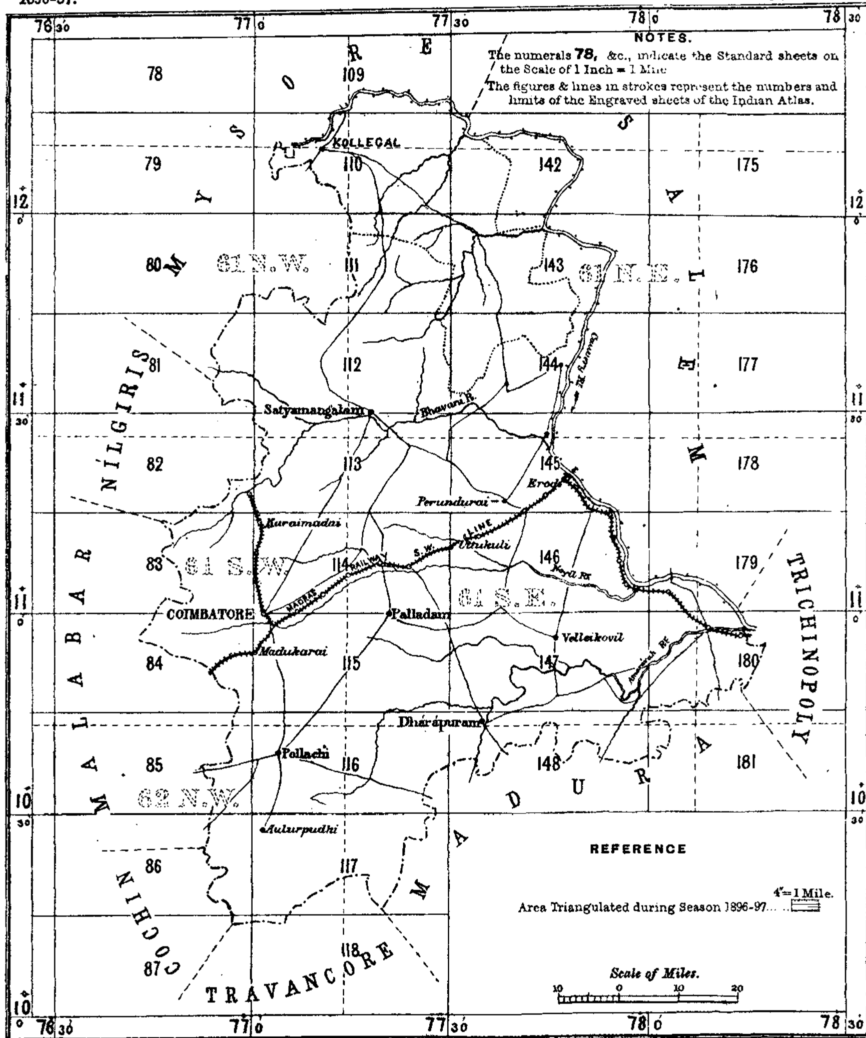


Photo., S. I. O., Calcutta.

No. 452-S. 97.

MADRAS SURVEY.

1896-97. **INDEX TO THE FOREST SURVEYS IN THE COIMBATORE DISTRICT** No. 9 PARTY.



Reg/No. 326, S. I. D.—Nov. 97.—550.

Photo., S. I. O., Calcutta.

No. 453-S. 97.

Southern Circle.—Advance triangulation in the Mángaon and Mahád *tálukas*, Kolába district, in sheets Nos. 168 and 290. Traversing in Sirsi *táluka*, North Kánara district, in sheet No. 280. Commencement of 8-inch detail in Roha *táluka*, Kolába district, in sheet No. 167. Continuation of 4-inch detail in Sirsi *táluka*, North Kánara district, in sheet No. 280.

162. The recess office of the party was inspected by the Surveyor-General at Poona in September, who was thoroughly satisfied with the state of efficiency in which he found the party.*

MADRAS PRESIDENCY.

No. 9 Party.

163. This party was transferred from the Central Provinces to form a second Madras Forest party. It commenced operations on the 4-inch scale on the Pachaimalai range in the Trichinopoly district and remained in charge of Mr. E. J. Jackson up to 21st July 1897 after which Captain Fraser held charge of it.

Personnel.

Mr. E. J. Jackson Officiating Superintendent, 1st grade, in charge up to 21st July 1897.
Captain H. A. Denholm Fraser, R.E., Deputy Superintendent, 1st grade, in charge from 22nd July 1897.
Mr. H. Dowman, Extra Assistant Superintendent, 2nd grade, to 10th April 1897.
Mr. A. G. Wyatt, „ „ 2nd grade, from 8th November 1896.
Mr. W. C. G. Barckley, „ „ 6th grade.
Mr. P. A. Peters, „ „ 6th grade, died on 20th March 1897.
Mr. C. George, „ „ 6th grade.
Mr. J. Donaghey, Sub Assistant Superintendent, 3rd grade.

Surveyors and Sub-Surveyors.

Bapu Jadu and 36 others.

The triangulation was entrusted to Mr. Barckley, who left Calcutta early in September. Mr. Dowman was put in charge of the traverse work and left the Central Provinces about the same time. The rest of the party excepting a few men who were employed in the Central Provinces to the end of December, left Kamptee for Trichinopoly about the end of October. Mr. George and afterwards Mr. Wyatt as well were placed in charge of detail sections.

164. The detail work could not be commenced till the values of the triangulated and traversed stations had been computed in the field, and an attempt was made to train the native surveyors in plane-table work during the enforced period of idleness, but with indifferent success, as they had never used a plane table before. Many serious difficulties were encountered at first and very great trouble was experienced in obtaining local *khalásis*. All those first entertained at Trichinopoly absconded when moved off to the scene of operations, and, owing to the evil reputation of the Pachaimalai Range, the men subsequently recruited in the vicinity could not be persuaded to sleep on the hills for fear of fever and returned to their homes at the foot of the hills every evening. Much valuable time was thus lost and progress was also greatly retarded by heavy rain and dense mists up to the middle of December. Practically no detail work was completed before the end of December, and, though after this date matters improved somewhat, the inexperience of the native surveyors in detail work prevented any but the slowest progress being made. Much assistance was given by the temporary transfer of two experienced surveyors from No. 19 Party (Madras Forests) as the effective native staff was very much too small compared with the number of European assistants attached to the party. A large number of the sub surveyors turned out very little, and in some cases absolutely no work at all throughout the season.

165. Plane-tabling was carried on in the Trichinopoly district until the middle of April, whilst preparatory work was commenced in the Coimbatore district in February and was continued till early in August with a view to giving the detail surveyors a fair start next year.

The area triangulated in Trichinopoly district is 250 square miles of which the computations were done in the field. About 1,200 square miles was also partially completed in the North Coimbatore district, which will however require sup-

*Messrs. Tapsell, S. Norman and C. Norman have carried on their duties satisfactorily, while, as regards the Native establishment, the officer in charge reports that, with one or two exceptions, the sub-surveyors worked well throughout the field season. Surveyor Joshi carried out some very good triangulation. The party lost the services of two of the best sub-surveyors, *viz.*, Virapa Piraji and Raghunath Narayan, from death, and of surveyor Gopal Vishnu, who retired on pension after thirty years' approved service.

plementing before it can be considered complete. The traverse work executed in Trichinopoly consisted of 244 linear miles, most of which was computed in the field and 280 linear miles have been traversed in the Coimbatore district.

166. The outturn of topography consists of 120·8 square miles on the 4-inch scale in the Trichinopoly district, where the whole of the work allotted to this party was completed. No other detail work was commenced, and the smallness of the outturn is due to causes previously mentioned.

167. Apart from the difficulties in procuring local labour, the country presented no special difficulties to the surveyor, but the climate proved hot and malarious and appeared to have a very enervating effect on the surveyors, all of whom were natives of Northern India.

168. The work was tested principally by fixings *in situ* supplemented by test lines with the chain where the nature of the country permitted of use being made of this method. The detail was found accurate, but the contouring is very defective owing to the inexperience of the surveyors.

169. The health of the party was not good and much fever prevailed and caused the death of 8 or 9 *khalásis*. Mr. Peters became seriously ill and had to be sent to Bangalore on leave, before the expiration of which he died.

170. During the recess the computations were proceeded with and considerable progress was made, but some of them cannot be finally completed till supplementary observations have been taken next season.

The mapping of the Pachaimalai Forests has been completed and will shortly be sent to Calcutta for publication: as there were no experienced draughtsmen in the party, assistance in this respect was asked for and obtained from No. 19 Party.

171. The cost rate amounts to R349-8-6 per square mile. It must be considered an altogether abnormal rate for the following reasons :—

(1) The native establishment had not been trained in the duties required from them, and much expense was incurred in attempting to train them in the field, an attempt which in many cases failed entirely.

(2) No preparatory work had been executed in advance and a large proportion of the establishment had therefore to remain idle in camp for many days, as work could not be provided for them.

(3) The expense of moving the party by rail from the Central Provinces was very heavy and a large outlay had to be incurred in providing tents for the menial establishment.

(4) A large number of up-country *khalásis* had to be employed and the rail charges on this account are necessarily heavy. All these defects will, it is hoped, be remedied next year. Under any circumstances the first year in new country, even when all hands are experienced, must necessarily show a high cost rate, and in this case the expenditure was immensely increased, as the natives were all untrained to topographical work, almost all of them having been engaged and trained for traverse purposes only in the Central Provinces, where the party has been working for so many years.

172. The party was inspected in the field by the Deputy Surveyor-General at the end of December 1896; and in August 1897, when in recess quarters at Bangalore, it was also inspected by the Surveyor-General in September. It was decided to effect an amalgamation with No 19 Party, and this was carried out from 1st September 1897 and will undoubtedly be the means of effecting great economy. A redistribution of the combined establishments into detail camps for the different districts has been carried out and steps have been taken to train 12 or 15 apprentices with the view of adding another detail section to the combined parties as soon as possible. The details of the revised programme for the combined parties are given in the report of No. 19 Party, which will be found at page 36.*

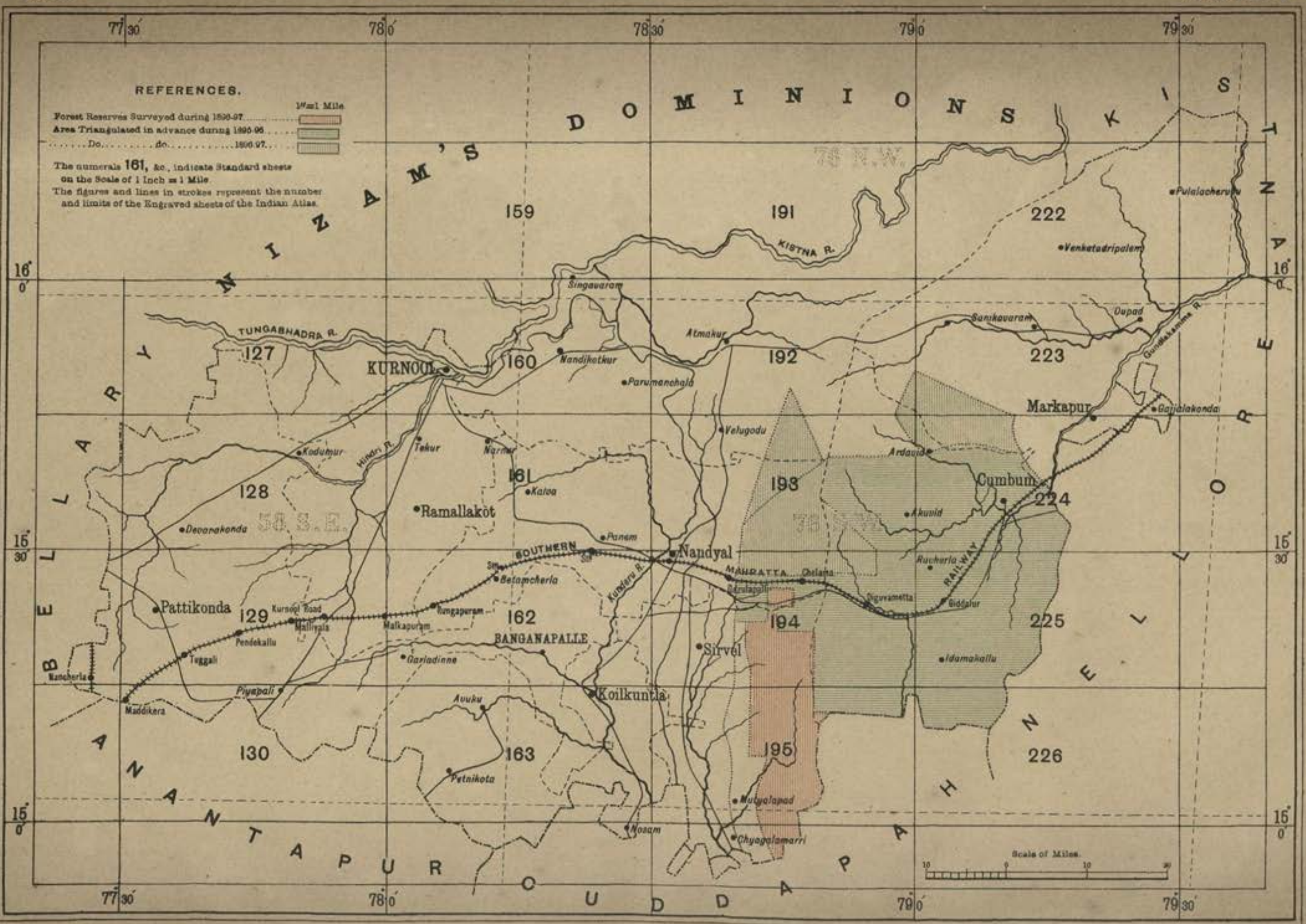
* The officer in charge at the request of Mr. Jackson reports very favourably on the work of Mr. C. George and speaks well of the zeal shown by Mr. Donaghey, who has not been long in the Department. It is necessary to mention that Mr. Barckley failed signally to carry out his orders, and has been a source of frequent trouble to the Executive Officer. Of the native establishment, Sub-Surveyor Hilaluddin is deserving of special mention for exemplary behaviour and consistently good work under trying circumstances. Computer Lall Mohun is a most reliable man with a thorough knowledge of his duties; and mention must also be made of the Writer, Tara Prasanna Roy, who has never failed to do his work satisfactorily.

The majority of the sub-surveyors failed to do good work, as already explained in the report, and many of them have been discharged or transferred to Revenue parties.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE KURNOOL DISTRICT.

1896-97. No. 19 PARTY.



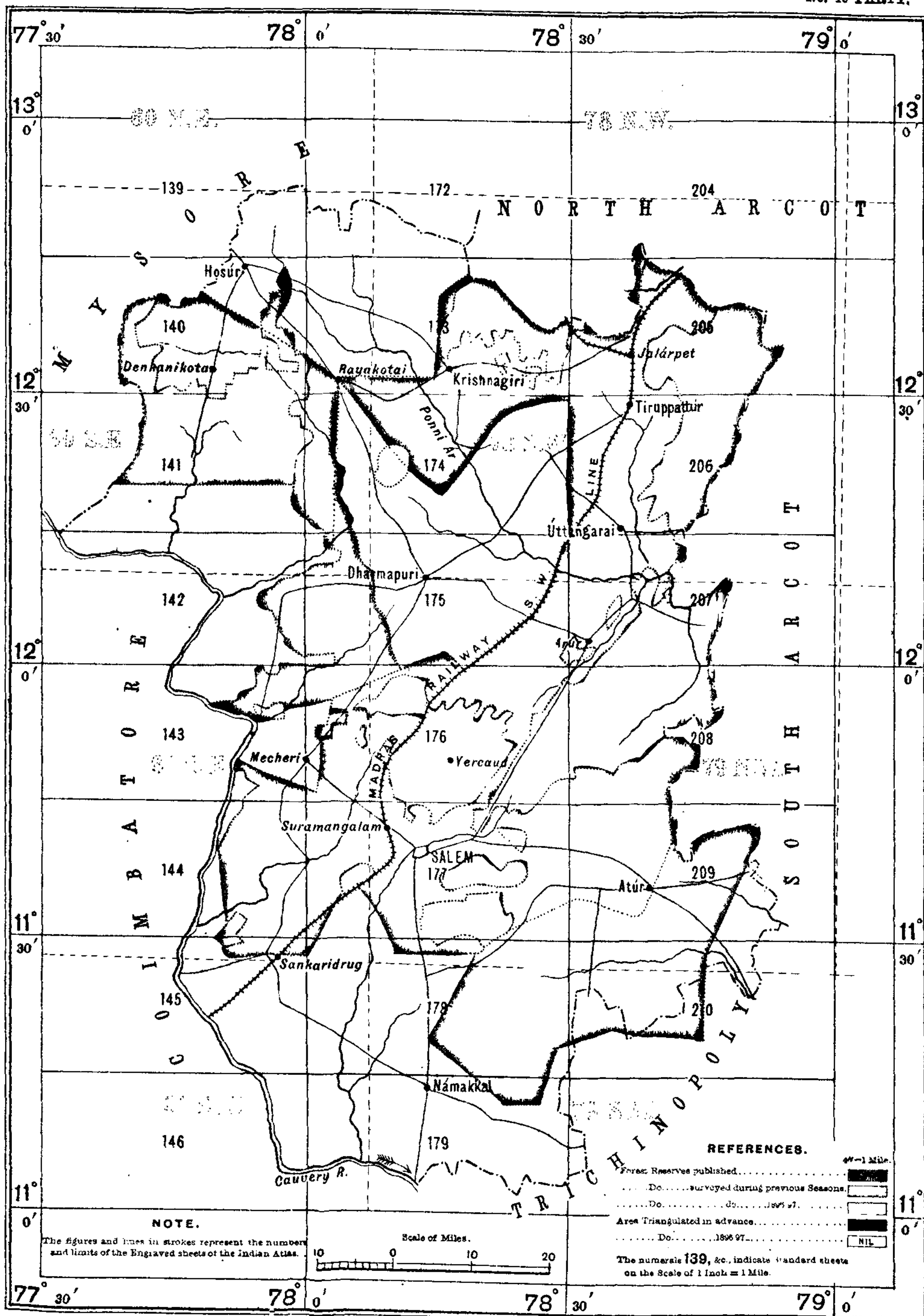
Reg. No. 505, S. I. D.—Jan. 98.—500.

Photo., S. I. O., Calcutta.
No. 304-S. 98

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE SALEM DISTRICT.

1896-97. No. 19 PARTY.



Ref. No. 305, S. I. D.—Jan. 98—550.

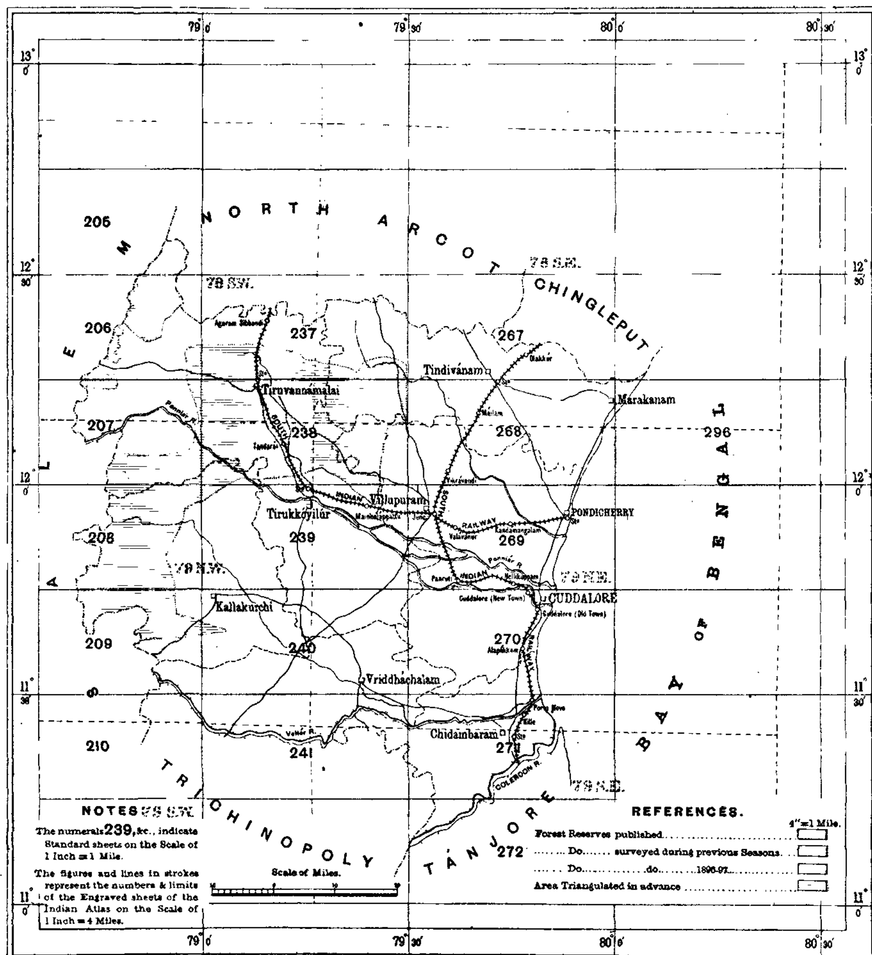
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No. 305-S. 98.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE SOUTH ARCOT DISTRICT.

1896-97. No. 19 PARTY.



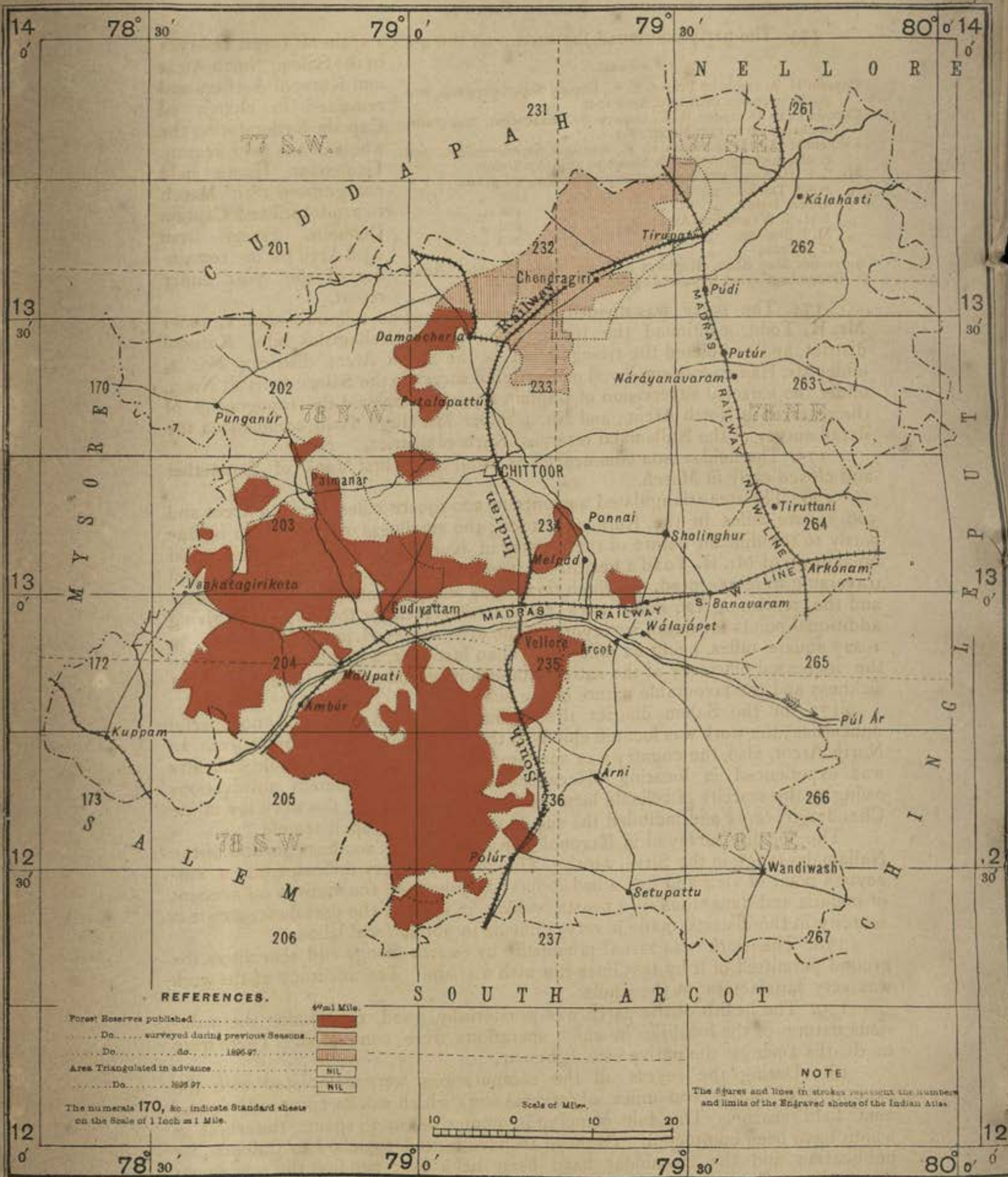
Reg. No. 334, S. I. D.—Sep. 97—550. Photo., S. I. O., Calcutta.

No. 440-S. 97.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE NORTH ARCOT DISTRICT.

1896-97. No. 19 PARTY.



Reg. No. 303, S. I. D.—Jan. 98.—550. Photo., S. I. O., Calcutta.

No. 310-S. 98.

MADRAS PRESIDENCY.

No. 19 PARTY.

173. The party continued the survey on the 4-inch scale of forest reserves in the Salem, North Arcot and Kurnool districts and remained in charge of Captain Ryder during the whole of the field season. Lieutenant Hume held charge from 18th March to 22nd April and Captain Denholm Fraser from 23rd April for the remainder of the year under report.

Personnel.

Captain H. A. Denholm Fraser, R. F., Deputy Superintendent, 2nd grade, in charge from 23rd April 1897.
Captain C. H. D. Ryder, R. E., Deputy Superintendent, 2nd grade, in charge up to 17th March 1897.
Lieutenant A. H. B. Hume, R. E., Assistant Superintendent, 2nd grade, in charge from 18th March to 22nd April 1897.
Mr. C. F. Hamer, Extra Assistant Superintendent, 3rd grade.
" Hugh Todd, " " " 4th "
" Robert Todd, " " " 4th "
" J. H. S. Wilson, Sub-Assistant " 2nd "
" M. J Sheehan, " " " 2nd "
" C J. Veale, " " " 3rd "
Surveyors Sher Shah, Raghava Ayengar, Tiruvenketsami, Balaji Dhondiba, Govind Raju, and 29 Sub-Surveyors, etc.

174. The party was divided into four sections as follows:—No. 1, under Mr. R. Todd, continued the triangulation of the Nallamalai hills, Kurnool district, and completed the triangulation of the South Arcot district; No. 2, under Mr. Hamer, was employed on the detail survey in the Salem district; No. 3, under the personal supervision of Captain Ryder, completed the topography of the reserves in North Arcot; and No. 4, under Mr. Hugh Todd, commenced the detail survey of the Nallamalai reserves, Kurnool district.

175. The field season commenced as usual in the first week of September and closed early in March.

176. The area triangulated amounts to 500 square miles in South Arcot and 500 square miles in the Kurnool district; the smallness of the outturn is due partly to the difficult nature of the country in Kurnool and partly to the partial breakdown of Mr. R. Todd's health. Seven hundred and twenty-eight miles of traversing were executed, of which 602 miles were run along forest boundaries and the remaining 126 miles were along roads, etc., for the purpose of giving additional points for detail surveyors. The area surveyed in detail amounts to 1,027 square miles, being 62 miles more than last year, a result due partly to the increased efficiency of the native establishment and partly to the absence of sickness and the favourable nature of the season.

177. In the Salem district the country surveyed presented no special difficulties; the work was located chiefly in the Hosúr and Dharmapuri *taluks*. In North Arcot, also, the country was moderately easy, but considerable difficulty was experienced in locating places named in the Government notifications owing to the scarcity of reliable local guides. The whole of the work lay in the Chendragiri *taluk* and included the site of the famous Tirupati temple.

The locality surveyed in Kurnool consists of the southern portion of the Nallamalai range in the Sirvel *taluk*. The country is very difficult from a surveyor's point of view and has a bad reputation amongst the natives on account of malaria and dangerous wild beasts, which, in spite of the prevalence of great scarcity in the district, made it very difficult to obtain local labour.

178. The work was tested principally by *in situ* fixings and also where the ground permitted of it by test lines run with a chain. The accuracy of the work was very satisfactory on the whole.

179. The health of the party was wonderfully good, considering the malarious nature of the localities in which operations were conducted. There were no deaths amongst the native establishment.

180. During the recess all the computations were completed with the exception of about 100 miles of traverse work which will be computed during next field season. The fair mapping is comprised in 30 sheets, the whole of which have been completed. Of these 16 have been despatched to Calcutta for publication and the remainder have been held over pending the settlement of certain small corrections and omissions. They will be corrected in the field and despatched to Calcutta before the end of the year. There are therefore no arrears of mapping.

181. The cost rate for the past year is R82-12-8 per square mile as against R65-14-4 last season, showing an increase of R16-14-4 per square mile. This

increase is chiefly due to the following causes:—(1) extra cost of operations in Kurnool district, where the establishment of menials had to be increased more than 30 per cent., compensation for dearness of provisions had to be given, as well as extra travelling allowance; (2) the posting of Lieutenant Hume and Mr. Veale to the party with a view to their being trained; and (3) the increased cost of the triangulation operations in Kurnool.

182. The recess office of the party in Bangalore was opened on the 8th March. The party was inspected by the Deputy Surveyor-General in August, and by the Surveyor-General in September.

183. Under orders from the Surveyor-General, the amalgamation of Nos. 9 and 19 Parties into one double party under a single executive officer took place on the 1st September 1897. The programme for the combined parties as approved by the Board of Revenue, Madras, is as follows:—

Three sections will be employed on triangulation; one to continue work in the Nallamalai hills, Kurnool district; another to commence the triangulation of the north of the Cuddapah district; and the third to complete the triangulation of North Coimbatore.

Traversing will be continued in Kurnool and North Coimbatore and commenced in Cuddapah and a certain amount will also be done in Salem and South Arcot districts.

Three detail camps will be employed: the first will complete the remaining work in Salem and possibly execute a small portion in the South Arcot district adjoining; the second will continue the work in the Kurnool district; and the third will commence operations in the Bhaváni *taluk*, North Coimbatore district.

In addition, a training camp for apprentice sub-surveyors will be established in the Salem district.*

LOWER BURMA.

No. 20 Party.

Personnel.

Captain P. J. Gordon, I.S.C., Officiating Deputy Superintendent, 1st grade, in charge.
Lieut. H. J. Hare, R. E., Assistant Superintendent, 1st grade.
Mr. W. A. Wilson, Extra Assistant Superintendent, 1st „
„ A. Ewing, Sub „ „ 1st „
„ H. A. Chartier, „ „ „ 2nd „
„ C. A. O'Donel „ „ „ 3rd „
36 Surveyors, Sub-Surveyors, etc., 1 Writer, 2 Hospital Assistants.

184. This party continued under the charge of Captain Gordon until 12th May 1897, when he made over charge to Lieutenant Hare. Its programme consisted of—

(1) Traverse survey in advance of detail survey of forests in the Shwegyin and Pegu forest divisions.

(2) The detail survey on the 4-inch scale of forest reserves in the Shwegyin and Pegu forest divisions, and on the 2-inch scale of unreserved forests in the Toungoo district.

185. The party left recess quarters in Bangalore in the middle of November 1896 and commenced field work during the first week in December. The return to recess quarters was made by the first week in June 1897. Experience shows that December as a rule is too early to commence work in these forests and most of the severe cases of sickness occur in this month; but the field season is already a short one, the heavy rains generally setting in by the middle of May.

186. The outturn for the season is as follows:—

Traversing	512	square miles.
Topography, 4-inch	395	„ „
„ 2-inch	106	„ „

No triangulation was carried out this year, the existing G. T. stations being considered sufficient to check the traverses. The traverse work was conducted by Mr. Wilson and again shows an improvement in quantity and quality considering his reduced staff. The angular measurements were checked by 146 sun azimuths giving good results.

* The officer in charge has much pleasure in reporting favourably on the work of Messrs. Hamer and Hugh Todd who have shown constant zeal and ability in the execution of their duties.
The surveyors and sub-Surveyors have worked well throughout, with the exception of apprentice Sub-Surveyors, Balran Jadu and Singaravelu Mudaliar.

BURMA SURVEY.

INDEX TO THE FOREST SURVEY IN LOWER BURMA.

1896-97. No. 20 PARTY.

NOTES.

The numerals **230**, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

Each 1-Inch Standard sheet is divided into four parts on the Scale of 2 Inches = 1 Mile, which are entitled 230 N.W., 230 N.E. and these 2-Inch sheets are [illegible] divided into four sheets on the Scale of 4 Inches = 1 Mile, and are entitled 230 $\frac{N.W.}{1}$, 230 $\frac{N.W.}{2}$, &c. *(vide diagram)*.

N.W. 1	N.W. 2	N.E. 1	N.E. 2
N.W. 3	N.W. 4	N.E. 3	N.E. 4
S.W. 1	S.W. 2	S.E. 1	S.E. 2
S.W. 3	S.W. 4	S.E. 3	S.E. 4

The figures and lines in strokes represent the number & limits of the *engraved* sheets of the Indian Atlas.

REFERENCES.

Sheets published are shown thus.................. (227)

Surveyed during previous seasons. ....

.......Do...... 1896 97 on 2-Inch Scale...............

.......Do...... 1896 97 on [illegible] Inch Scale...............

Area Triangulated and Traversed in advance.....

Area Triangulated in advance but not Traversed.



Reg. No. 349, S. I. D.—Jan. 98 —550.

Photo., S. I. O., Calcutta.

No. 301-S. 98.

187. The principal portion of the detail work in the Shwegyin forest division was under Mr. Ewing. Mr. Charrier and Mr. O'Donel were employed on 4-inch work, the former also testing some plane tables late in the season. The work was systematically tested both by the officer in charge and assistants.

188. The outturn of 4-inch work shows a satisfactory increase on former years, although the country was more broken and the jungle to some extent worse than in previous seasons.

The cost rate calculated as in former years shows a small increase, though in reality the work is again cheaper. This is partly explained by the share of supervision, etc., that formerly was taken by the triangulation falling this year on the detail work; and partly by the extra cost of an Assistant Superintendent and a probationary Sub-Assistant Superintendent attached to the party, more for the purposes of training than because they were actually required. The total cost of the party for the year is practically the same as last year, but the outturn of finished survey shows a considerable increase. The cost of the work should continue to decrease, especially as the most difficult parts of the country have now been completed.

189. The country was much the same as described in former years, except that the work lay wholly in the hills, and the jungle for about 100 square miles was worse than any yet experienced.

190. The health of the party this season was again bad, the deaths being one sub-surveyor, four *khalásis* and one interpreter. Severe sickness generally shows itself in January and few, if any, of the party escaped during the first month of their return to India.

Tigers and elephants were a source of much trouble, the men being badly scared by them at times. Fortunately no deaths occurred from this cause, though a *khalási* was seized and carried out of a hut at night. It is supposed that his escape with nothing worse than a severe bite was due to the tiger stepping back into the camp fire. Twenty guns were obtained from the Local Government and issued to the surveyors working in the worst parts; they were of great assistance in giving the men confidence.

191. No supplies were available in the country where the surveyors were working with the exception of a little rice from Karen villages. The usual arrangements were made by means of depôts for feeding the men, and though the difficulties were great the supplies were successfully kept up.

192. During the recess all the computations and 4-inch fair mapping were brought up to date and thirteen 4-inch sheets were submitted for publication. Considerable progress was also made with the charts and general report of the party's work.

193. The programme for next season comprises :—

(1) The detail survey on 4-inch scale of the remainder of the Aingdon Kun, North Zamayi and Yenwe reserves. Also the Kadat, South Zamayi Nyabwa and Zahakawliya reserves.

(2) The traverse survey in advance of Shwelaung Kodugwe extension and Mayan reserves and unreserved forests in the Pegu district.

194. The party was inspected in the field by Colonel Sandeman, Deputy Surveyor-General, in February 1897, and in recess quarters by Lieutenant Colonel Hobday, I.S.C., Officiating Deputy Surveyor-General, in July 1897.

The Surveyor-General also inspected the recess office of the party in September 1897.*

OPERATIONS OF THE FOREST SURVEY BRANCH.

195. The administration and control of this special branch is in the hands of the Inspector General of Forests, while the direct supervision of the survey operations remained, throughout the year, in the hands of Mr. W. H. Reynolds, Superintendent of Forest Surveys.

* The officer in charge reports that Mr. Wilson deserves credit for the able way in which he has carried out the traverse work.

Mr. Ewing performed his duties most satisfactorily both in field and recess, and showed much energy and self-reliance.

Of the native establishment Amjad Ali, Sharfuddin, Kyaw Nyeing, Zahur Hasan, and A. M. Rodrigues are deserving of special mention.

196. With the exception of the surveys in Oudh, which had already been brought to a close, the operations which were in progress during the preceding season, were all continued during the year under report, *viz.*, those in the forest divisions of Ráipur, Bálághát, Nágpur-Wardhá, Seoni, Chhindwárá and Saugor in the Central Provinces; Chamba in the Punjab; Salween-Ataran in Lower Burma, and Pyinmana in the Eastern Circle of Upper Burma. In addition to the above, the survey of the forests in the Ruby Mines district of Upper Burma was taken in hand.

197. The several provincial field parties were divided into 9 separate detachments, 3 of which worked under the immediate supervision of a Deputy Superintendent (Mr. E. Litchfield) and each of the others worked under European supervision or under reliable and trustworthy native assistants.

198. The total outturn for the year is as follows :—

Triangulation			2,562 square miles.
Traversing			368 linear miles.
Detail Survey	1-inch scale	802	2,365 square miles.
	4 "	1,357	
	16 "	206	
Spirit levelling			934 linear miles.

199. Throughout the 4-inch topographical work, in the Central Provinces and Chamba, instrumental contours were run, as usual, at vertical intervals of 250 feet and in the 1-inch survey of Chamba they were run at 1,000 feet intervals. The topography was further checked by running a considerable number of *partál* or check lines through the work.

CENTRAL PROVINCES.

200. Five detachments of the Forest Survey Branch were employed during the year on field operations in the Central Provinces. The forests operated on were those in the districts of (i) Ráipur, (ii) Bálághát, (iii) Nágpur with Wardhá, (iv) Chhindwárá, and (v) Saugor. Later in the season, after the completion of the survey of Ráipur and Bálághát, the detachments working in these districts moved into the adjacent districts of Seoni and Bilúspur and continued field operations there until the close of the season. The several survey detachments took the field towards the end of November and, with the exception of the Ráipur party, returned to recess quarters by the end of June. The Ráipur detachment arrived at headquarters on the 16th July.

Personnel.

Mr. T. S. Marten, Extra Assistant Superintendent, 6th grade.
" J. Marten " " " 6th grade.
" C. Litchfield, Sub-Assistant " 2nd grade.
" J. H. Nichol " " 2nd grade.
Babu Odey Sing, Forest Surveyor.
79 Native Surveyors.

201. The following statement shows the areas surveyed by each detachment and the cost rate per square mile of each branch of the work :—

FOREST DIVISION.	TRIANGULATION.		TRAVERSING.		LEVELLING.		TOPOGRAPHY, CHIEFLY ON 4 INCH SCALE, INCLUDING FOREST GROWTH AND SOIL RECORD.	
	Area in square miles.	Cost rate per square mile.	Linear miles.	Cost rate.	Linear miles.	Cost rate.	Area in square miles.	Cost rate per square mile.
		R		R		R		R
Nágpur-Wardhá	...	...	...	...	300	4·3	225	37·4
Bálághát	...	...	...	...	...	...	168	37·0
Seoni	...	...	...	...	...	...	179	
Chhindwárá	...	...	...	...	...	...	219	46·9
Ráipur	...	...	35	10·1	476	6·4	165	53·7
Bilúspur	...	...	...	...	...	...	20	
Saugor	327	9·4	...	...	158	7·7	230	46·7
Mandlá	...	...	...	...	...	...	2	
TOTAL	327	...	35	...	934	...	1,208	...

202. Of the areas surveyed in detail 1,002 square miles were executed on the 4-inch scale and comprise the interior survey of the reserved forests, and 1,648 linear miles of forest boundary, with a strip of topography 5 chains wide on either side of the boundary, were surveyed on the 16-inch scale in full topographical detail and comprise a superficial area of 206 square miles. The latter surveys have been made for the purpose of securing a large scale and indisputable boundary record of the forest reserves. The outturn of the previous season was 1,025 square miles on the 4-inch scale and 127 square miles on the 16-inch scale.

203. The only district, in which it was found necessary to do any additional triangulation, was Saugor, and this work was done by Mr. T. S. Marten. In the districts of Ráipur, Nágpur and Wardhá, however, in the denser parts of the forests where the trigonometrical stations were few and far apart, as well as in portions of the Saugor district it was found necessary to run lines of spirit levels to afford a sufficient and ample basis for adding instrumental contours to the topographical work. The only traversing that was necessary during the season was that required for connecting the existing traversing with the triangulation of the province, and these connections were only made where the traverse lines passed within easy distance of a trigonometrical point.

204. The topographical work was tested by running 1,399 miles of *partál* or check surveys through it and the instrumental contours, which were run at 250 feet vertical intervals, also afforded a further check on the detail survey.

205. In the way of mapping a large amount of work has been got out of hand. Out of a total of 433 sheets, 254 have been published and the remainder are either passing through the press or are in hand. Of these 202 were completed in previous seasons.

206. The total expenditure was R64,663, of which R61,303 was on account of surveys that are in progress, and R3,360 was expended on drawing and photozincographic charges for forest maps of the Jubbulpore, Narsinghpur and Bhandára divisions and of areas previously surveyed. The average cost rate of the detail topographical surveys was R43 3 per square mile, as compared with R41·6 in the previous year and R50 in 1894-95.

207. Mr. W. H. Reynolds, Superintendent of Forest Surveys, was in the Central Provinces from the 27th February to 17th March, and satisfied himself that the field work of the survey detachments was being efficiently conducted.

PUNJAB.

Personnel.

Mr W. H. Reynolds, Superintendent, 2nd grade.
" J. Marten, Extra Assistant Superintendent, 6th grade.
10 Native Surveyors.

208. The survey of the Chamba State and Government leased forests was in continuation of the previous year's operations. The leased forests are being surveyed on the 4-inch scale and the rest of the State is being mapped on the 1-inch scale for topographical purposes.

209. The field season extended over various limited periods throughout the year which were determined by the nature of the climate in the Himálayas.

210. Nothing in the way of triangulation was done, as this branch of the work was sufficiently in advance for the season's topographical work. A considerable area, however, has been flagged in advance for the coming season's triangulation.

211. Topographical operations on the 1-inch scale extended over the Tisa, Chamba and Barmaur ranges; the 4-inch surveys were also confined to the forests in those ranges. Instrumental contour lines were run throughout the 4-inch surveys at vertical intervals of 250 feet, and similar contours were run through the 1-inch work at vertical distances of 1,000 feet.

212. The following statement exhibits the areas completed during the year, as well as the cost rates per square mile:—

State.	Description.	Area in square miles.	Cost rate per square mile.
			R
Chamba . . .	Topographical survey 4-inch scale.	87	29·8
	Ditto ditto, 1-inch scale.	802	8·5

213. Of the total expenditure in this province, *viz.*, R11,124, the expenditure on account of survey operations in the Chamba State amounted to R9,731,

whilst R 1,393 were expended on mapping and the publication of the 4 and 1-inch sheets of the Bashahr State.

214. Mr. W. H Reynolds, Superintendent, Forest Surveys, was in the Chamba State for about two months during the summer and again in September personally directing the survey operations; and Mr. J. Marten was with the Chamba party from the 21st August to the close of the survey year, examining and testing the details of the topographical survey.

BURMA.

215. Three detachments were employed during the year on field operations in Burma and the forests operated on were those in the forest divisions of—

Personnel.
Mr. E. Litchfield, Deputy Superintendent, 2nd grade.
29 Native Surveyors.

Salween-Ataran in Lower Burma.
Pyinmana } in Upper Burma.
Ruby Mines }

The above detachments were under the immediate charge of Mr. E. Litchfield, Deputy Superintendent.

216. The surveys in the Salween-Ataran and Pyinmana divisions were in continuation of the previous season's operations, and the operations in the Ruby Mines division were taken in hand during the year under report.

217. The surveyors left Dehra about the middle of November and returned to recess quarters at the end of June.

218. The Salween-Ataran and Pyinmana detachments were employed on traversing and detail survey on the 4-inch scale, while the Ruby Mines detachment was engaged on preliminary work of triangulation and traversing, as a basis for the following season's topographical survey. Some triangulation was also done in the Salween-Ataran division.

219. The triangulation in the Salween-Ataran division was done by Babu Salig Ram, under very trying circumstances, and he succeeded in connecting it satisfactorily, by long rays, with the previous triangulation. In the Ruby Mines district the triangulation in the forest tracts was done by Babu Mittan Lal, and the connecting lines, between the Mandalay series of the Trigonometrical Survey and the Forest Survey triangulation, which necessitated observations at four different stations, was done by Mr. E. Litchfield, Deputy Superintendent. The observations on the connecting triangles are very incomplete and can scarcely be considered satisfactory. The failure to obtain complete observations for the connecting triangles is attributed, by Mr. E. Litchfield, to the season being an unusual one in as much as hazy weather set in as early in the season as the 19th December, and it was only at occasional intervals, for a day or so at a time, that the atmosphere partially cleared. When Mr. Litchfield discovered that he had difficulties of this nature to contend against so early in the season, there is no reason why he should not have effected a connection, by shorter rays, with the existing trigonometrical stations farther south, instead of losing valuable time between December and March in making useless attempts to secure observations to unusually distant stations. A second connection with the Mandalay Meridional series with shorter rays will be effected during the early part of the coming field season, as a check on the previous season's triangulation.

220. The following statement shows the areas completed and the cost rate of each class of survey :—

FOREST DIVISION.	TRIANGULATION.		TRAVERSING.		DETAIL SURVEY ON 4-INCH SCALE.	
	Area in square miles.	Cost rate.	Linear miles.	Cost rate.	Area in square miles.	Cost rate.
		R		R		R
Salween-Ataran	523	7 7	109	29·1	97	99 3
Pyinmana	...	...	83	45·1	171	105·2
Ruby Mines	1,712	7·7	165	33·4	...	...
TOTAL	2,235	...	357	...	268	...

BURMA SURVEY.

INDEX TO THE CADASTRAL SURVEY IN UPPER BURMA.

1896-97. No. 3 PARTY.

REFERENCES.

Surveyed during previous Seasons on Scale 16 Inches = 1 Mile and 2" = 1 Mile.

Surveyed during 1896-97 on Scale 16 Inches = 1 Mile.

Surveyed during 1894-95 on Scale 8 Inches = 1 Mile.

Traversed in advance.

District Boundary

Township do.

Forest do.

NOTE.

The numerals 121, &c., indicate the Standard sheets on the Scale 1 Inch = 1 Mile.

Scale of Miles.



Reg. No. 481, S. I. D.—Dec. 97.—450.

Photo. S. I. O., Calcutta.

No. 472-S. 97.

221. The angular measurements on the traversing were checked by 66 azimuth observations and the distances by connections with trigonometrical stations. The detail survey was checked by running 186 miles of *partál* lines through the topographical work.

222. The mapping is well advanced, out of a total of 53 sheets, 40 have been published and the remaining 13 are either in the press or in progress.

223. The total expenditure on the above operations, including the season's mapping and other charges connected with the Burma surveys, amounted to R57,253, as against R29,792 in the previous year. The increase is due chiefly to an additional Forest division (Ruby Mines) having been brought under survey during the year, as well as, to the fact that it was found necessary to put a Deputy Superintendent, Mr. Litchfield, in charge of the survey operations, thereby increasing the total cost by his pay and allowances.

224. Mr. W. H. Reynolds, Superintendent of Forest Surveys, was in Burma from the 18th January to the 19th February; and visited in turn, each of the survey detachments and inspected the various branches of the field work that were in progress.

225. Further details of the work carried on by the Forest Survey Branch and index maps illustrating the survey operations, will be found in the Progress Report on the operations of the Branch published under the direction of the Superintendent of Forest Surveys.*

CADASTRAL SURVEYS.

MYINGYAN, KATHA, UPPER AND LOWER CHINDWIN DISTRICTS, UPPER BURMA.

No. 3 Party.

226. Up till 11th December 1896, Mr. G. H. Cooke held charge of this party when he retired on a superannuation pension. From the 12th December to the end of the season, Mr. E. G. Little, Extra Assistant Superintendent, 2nd grade, was given charge of it, there being no Imperial officer experienced in cadastral surveys available at the time.

Personnel.

Mr. G. H. Cooke, Superintendent, 2nd grade, in charge up to 11th December 1896.
„ E. G. Little, Extra Assistant Superintendent, 2nd grade, in charge, from 12th December 1896.
„ J. Connor, Extra Assistant Superintendent, 4th grade.
„ G. C. Swiney „ „ 5th „
„ C. W. Wilson, „ „ 5th „
„ A. George, „ „ 6th „
„ W. J. Baker, Sub-Assistant Superintendent, 1st „
„ O. C. Ollenbach, „ „ 2nd „
„ W. Newland „ „ 2nd „
Babu H. K. Roy, „ „ 3rd „
Mr. E. G Hardinge, „ „ 3rd „
98 Sub-Surveyors and others.
10 Inspectors.
100 Field Surveyors (Indians).
20 „ „ (Burmans).

227. As has been the case with this party for the last two or three seasons, the programme was most varied and scattered over no less than eight districts. It consisted of—

(1) The completion of the traverse and continuation of the field survey of the Myingyan district.
(2) The traverse and cadastral survey of some of the valleys in the Minbu district, omitted by No. 12 Party.
(3) The traverse of a portion of the Lower Chindwin district.
(4) The continuation and the completion of the traverse and cadastral survey of the Katha district (including the survey on 8-inch scale of two gold blocks).
(5) The continuation and completion of the traverse and cadastral survey of the Upper Chindwin district and the revision of certain portions.
(6) The cadastral survey of 22 villages in the Shwebo district.

* Mr. Reynolds reports most favourably of all his European Assistants and specially mentions Mr. J. Marten, as being an able surveyor and as having done excellent work both in the Central Provinces and in Chamba.

Of the Native Surveyors, Salig Ram is highly commended for his zeal and ability in triangulation; Odey Sing, Dalip Sing, and Bhoop Sing, are mentioned as being good topographical surveyors, and Badri Dutt, and Bimala Charan Shome as good computers.

In office Kali Kanth Kar has done excellent work and is deserving of special mention, and Lalit Mohon Basak has also done good work.

(7) The cadastral survey of 45 villages in the Pyinmana sub-division of the Yamèthin district.
(8) The cadastral survey of seven outlying villages in the Mandalay district.
(9) The triangulation of a portion of the Myingyan district, and,
(10) Revised tracing and recasting of area statements according to the rearrangements of boundaries by Settlement Officers in districts Sagaing, Meiktila, Katha and Shwebo, etc.

228. The party left Mandalay between the middle and end of November and field operations were started on arrival of the camps at their destinations.

The return to recess was made during the months of May and June as each camp finished its work.

DISTRICT MYINGYAN.

229. The work in this district was simply a continuation of what had been done the previous year and consisted of the traverse survey of 881 square miles and the cadastral survey of 781 square miles.

The demarcation had been effected and the boundaries of *kwins* marked by wooden posts, but these were in most cases too far apart to indicate the boundary clearly; so the field surveyor often had to depend on the *thugyis* interpretation of it in the portions that intervened.

230. The traverse survey of this district which is now complete contains 10,014 stations and 2,085 linear miles of chaining; the angular measurements have been checked by 55 observations for azimuth, whilst the linear measurements have been connected with five triangulated points specially fixed from the nearest G. T. bases. Forty-two permanent marks, such as pagodas, were also connected with the traverses.

231. The cadastral survey was mapped on 1,041 sheets on the 16-inch scale and was checked by 2,033 linear miles of *partal*, giving an average of 2·6 miles of check line per one square mile of area. The average area of the field is 2·18 acres. Only about 1,000 square miles remain for detail survey in this district, and it is believed that next season will see it completed.

232. The country was in portions much cut up by ravines and covered with sparse vegetation, such as thorny trees and cactus, but still containing a good deal of upland cultivation, portions of which have been abandoned for the last two or three years, but which a more favourable season would soon see resumed. The want of water has been much felt in this district, and great difficulty was experienced in keeping the men supplied.

233. In the Pagan township the ruins of the town and fort of Pagan (one of the ancient capitals of Burma) are still to be seen and include many large pagodas, some few of which are kept in repair and visited by thousands of Burmans during their festivals. Surrounding the site of the old town for some miles in all directions lie the ruins of pagodas of all sizes and shapes, which can be numbered in hundreds and form a desolate picture but a characteristic feature of this part of the country. Pagan is now famed chiefly as the seat of the important industry of lacquer work manufacture, which appears to be the principal occupation of its present inhabitants.

DISTRICT MINBU.

234. The work in Minbu consisted of the traverse and cadastral survey of scattered villages along the valleys of Ngapè, Kyabin, Salin and Sidôktaya townships which had been omitted by No. 12 Party and maps of which were now called for by the Land Records Department to complete the district records. These valleys are situated at the foot of the Arakan Yomas, some miles to the west of the work done in this district by No. 12 Party, with which they had to be connected at intervals by traverse lines which had to be carried over very rough ground and through dense jungle, adding greatly to the labour and cost. They are as well known for the fertility of their soil as for the unhealthiness of their climate, and the men suffered a great deal from fever and dysentery while engaged in surveying them; this, added to the absence of definite information as to the extent of work required which demarcation maps could alone have supplied, prevented the district being finished. The demarcation was not started until

after work had actually commenced, and the traverse sub-surveyors were obliged to precede the demarcation officer, doing the best they could under the guidance of the *thugyis*. As it is believed that the lines run by the sub-surveyors fairly represent the limits of each *thugyis* charge, it would be advisable as much as possible to adopt the traverse stations as the boundary marks of the *kwins*. The detail survey comprised 160 villages which were mapped on 175 sheets on the 16-inch scale. The average size of the field is 0·74 of an acre. It was checked by 141 linear miles of chain lines.

235. The area remaining, which cannot be large, will be taken up and completed during the ensuing season.

District Upper Chindwin.

236. This district up to the Uyu river has been completed; all that was left for traverse and cadastral survey, in the portions allotted for work, having been taken up during the season. No demarcation had been attempted in this district, the survey being confined to the areas of cultivation wherever it was found, the limits of each area forming a block; where these blocks were large, they were divided up into *kwins* as pointed out by the *thugyis*.

237. The cadastral area comprised 317 villages which were plotted on 292 16-inch sheets; the average size of the field being 0·33 acre. It was not considered advisable to extend the survey to the north of the river Uyu as, though extensive tracts of cultivated land are reported as existing in the Hukong valley, it was considered too remote to be included in this year's programme.

238. The area surveyed is small, but is so scattered and with such masses of hills and jungle dividing the separate blocks of cultivation which had to be connected to each other by traverse lines that the cost and labour involved and difficulties experienced in surveying them are out of all proportion to the result.

District Katha.

239. The traverse operations in this district embraced nearly the whole of Pinlèbu, and parts of the Banmauk and Mansi townships, and are now completed. As in Upper Chindwin there was no demarcation in Katha and the same procedure that was carried out in this latter district had to be adopted here also. The angular measurements were as usual checked by astronomical azimuths, whilst the chaining was connected with four G. T. stations. In addition to the traverse stations 116 permanent objects, such as pagodas, were fixed by the traverse surveyors.

240. The cadastral survey covered an area of 229 square miles, leaving about 20 square miles in the Ga-nan circle to be completed next year, which will complete the district. This circle was at the request of the Deputy Commissioner included in our programme in the middle of the field season; it was traversed, but owing to the early setting in of the rains the detail survey could not be completed. The season's detail survey comprised 616 villages which were mapped on 654 sheets on the 16-inch scale. Chain lines aggregating 584 linear miles were run to check it. The average size of the field is 0·55 acre.

241. Most of the cultivation was found bordering the streams or lining the valleys, especially along the banks of the Mu river, which flows north and south through the township of Pinlèbu. All the difficulties experienced in Minbu and Upper Chindwin owing to unhealthiness of climate, rugged nature of country, difficulties of transport, and scattered style of work, were intensified in the portions surveyed this season of Katha. Not only was the work dotted over a vast area, but the difficulties were enhanced owing to the greater sparseness in the population of the country, the loftier and more rugged nature of its hills and its more deadly climate, all combining to swell the cost and make the work very expensive.

242. Two square mile blocks in the gold tracts traversed in season 1894-95 were surveyed topographically on the scale of 8″ = 1 mile, completing the surveys of the grants which have been applied for so far.

Districts of Shwebo and Yamèthin.

243. The work in these districts comprised the cadastral survey of 22 villages in the former and 34 in the latter traversed the year before, thus com-

pleting these districts. The area was mapped on 98 and 81 16-inch sheets respectively, and was *partalled* by 39 and 26 linear miles of chaining. The average size of the field in Shwebo is 5·7 and in Yamèthin 3·4 acres.

District Mandalay.

244. Seven outlying villages, which were not demarcated at the time of the survey of the district, were surveyed at the request of the local authorities.

District Lower Chindwin.

245. The whole of the country on the left bank of the Chindwin river having been demarcated, the traverse survey of the district was started and 482 square miles completed, the cadastral survey of which will, according to orders just received, be undertaken during the ensuing season. The tract brought under survey is chiefly a rice-bearing one and extends along the river bank and about two miles inland as far south as the Sagaing district. The principal road of the district is the bridged and partially metalled one, that connects Myinmu on the Irrawaddy in the Sagaing district, to Mônywa on the Chindwin the chief town of the district,—and is continued on to Ablow, the former capital. The greater part of the Chindwin-Mandalay trade is carried on by this route.

246. The total outturn for the season is shown in the following table :—

Districts.	Traverse Survey.		Cadastral Survey.		
	Number of villages.	Area in square miles.	Number of villages.	Number of fields.	Area in square miles.
Myingyan	835	881	782	230,161	781
Minbu	281	151	160	49,940	57
Upper Chindwin . . .	64	46	317	244,535	129
Katha	447	186	616	267,235	229
Shwebo	...	...	22	5,053	46
Yamèthin	11	16	34	10,551	56
Mandalay	...	...	7	6,783	2
Lower Chindwin . . .	361	482	...	...	...
Katha (gold fields) . .	...	2	...	...	2
Total .	1,999	1,764	1,938	814,258	1,302

247. In addition to the area traversed, as shown in the above statement, there are the lines which were run to connect the outlying blocks in the Upper Chindwin and Katha districts; the expenditure of time and money on these has been considerable, and there is little or nothing to shew for it. It is a question whether these should be run in future, now that topographical survey parties have been organised for the whole of Burma.

248. The usual precautions, such as the employment of two chains in the measurement of main and sub-circuit lines and the use of the clinometer for observing angles of elevation and depression in hilly ground were taken; the different camps and field parties were inspected frequently during the field season by the officer in charge, and every means adopted to ensure good work.

249. In accordance with the Deputy Surveyor-General's instructions, the *amins* were directed to ink up their sheets, and if capable of doing so, extract the areas of the fields surveyed by them before sending in their work; the system inaugurated, new as far as Burma is concerned, proved quite a success as regards the inking in of the maps, but the area work, whenever attempted by the *amins* leaves much to be desired, as most of the field areas have had to be re-estimated in office.

250. The Local Government having ordered cash to be paid daily for all labour employed, the sub-surveyors and *amins* had to be entrusted with money

to make these payments, but the system has proved a failure, as the men are not to be trusted to pay the coolies employed in full. The officer in charge strongly recommends the reintroduction of the old system, *viz.*, that of all payments being made by the European officers only, on production of vouchers by *thugyis*, signed by the sub-surveyor or *amin*. This system has proved a success in almost every district in which it was adopted, the only exception being, so far as is known, in the Upper Chindwin district, two or three years ago when there were no assistants available to visit the work which was situated far away from the rest of the area under survey and where some bills were left unpaid in consequence. The system here advocated not only ensures payment for all labour employed, but brings the *thugyis* into contact with the European Officers, who are thus enabled to enquire into any little differences that may arise between the *thugyis* and survey staff, and is beneficial in every way both to the work and the people of the country.

The rains having again failed, the season has been a very severe one, and the money paid for coolies, R13,484, must have been of some help in tiding the people over a time of scarcity. Four annas a day was generally paid, but in portions of Upper and Lower Chindwin and in Katha six and eight annas a day per man were demanded, which seemed to be very excessive, considering the rates that prevailed at the famine works, where the men were paid at only 2½ annas per day.

251. Thirty-eight Burman *amins* presented themselves for training in practical surveying. Seventeen of these belonged to Class I. and twenty-one to Class II of the Scheme of 1894. Seven joined the camp at Wuntho, and thirty-one the camp at Pagan. One man died and another went away ill and did not return; but the rest stuck to their posts and have been well trained, the work they turned out being very fair both in quality as well as in quantity.

252. After the first showers in April the men working in Minbu, Upper Chindwin, and especially in Katha, suffered terribly from fever and dysentery, in some cases whole squads including the *amin*, inspector and measurers, going down as one man. Only fourteen died in the field, but some have succumbed since, and many more have had their constitutions thoroughly shattered.

253. One sub-surveyor was deputed to the Marine Transport Department to survey the upper reaches of the Irrawaddy river above Bhamo.

254. The head-quarters and one camp were inspected at Mandalay and Pagan, respectively, during January last by the Deputy Surveyor-General, who expressed himself as well pleased with all he saw.

255. Relations with the district authorities were of the most cordial nature, all assistance asked for being readily afforded; and thanks are especially due to Mr. B. S. Carey, C.I.E., Deputy Commissioner of Myingyan, and Mr. Martin, the Sub-Divisional Officer of Wuntho.

256. Exclusive of the current season's work the following traces of *kwins*, as revised, were made for the Settlement Officers of Meiktila, Sagaing, Shwebo and Katha and for Calcutta, and a large number of volumes of the traverse work of previous seasons were examined, indexed and bound:—

District.	Tracings for Settlement.		Tracings for Calcutta.		Tracings of 4" & 2" sheets.
	Kwins.	Fields.	Kwins.	Fields.	
Sagaing	24	22,021	24	22,021	...
Shwebo	631	268,499	615	322,101	...
Do.	104	45,198	...	...	...
Meiktila	...	...	654	2,81,069	...
Katha	76	137,022	...	...	...
Yamèthin	Tracings prepared for Irrigation Department				28 four inch; 11 two inch.
Total	835	472,740	1,293	625,191	39

257. A second set of tracings of 18 two-inch sheets of district Meiktila was prepared for the Deputy Commissioner, and a tracing of 1 two-inch sheet of district Meiktila was prepared for Irrigation Department.*

BIHÁR.

No. 4 Party.

Personnel.

Captain R. T. Crichton, I.S.C., Deputy Superintendent, 1st grade, in charge.
„ C. W. H. Symonds, I.S.C., Officiating Deputy Superintendent, 2nd grade.
Mr. H. Dowman, Extra Assistant Superintendent, 2nd grade, from 21st September 1897.
„ A. W. Smart, Extra „ „ 5th „
„ C. S. Kraal „ „ „ 6th „
„ C. S. Gasper Sub „ „ 1st „
Babu Nilmoni Chatterjee „ „ „ 2nd „
Mr. P. K. Vaughan „ „ „ 2nd „
59 Supervisors and Inspectors.
10 Surveyors and Sub-Surveyors.
15 Computers.
249 Amins (local).
287 do. (imported).

Noákhálí detachment.

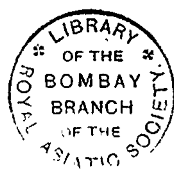
Mr. E. F. Berkeley, Sub-Assistant Superintendent, 1st grade in charge.
5 Inspectors.
6 Surveyors.
32 Amins.

258. The programme of this party as originally sanctioned by the Government of Bengal provided for the continuation of the Bihár surveys by one traverse section and two cadastral sections, and the areas to be completed were to have been 50 square miles of traverse and 500 square miles of cadastral survey in Sáran and 317 square miles of traverse and 600 square miles of cadastral work in the northern part of Darbhanga. Owing, however, to the threatened famine in North Bihár, orders were subsequently issued to the effect that the Sáran cadastral section should take up a small area in Thána Basantpur, and that the Darbhanga section should work in the south of that district instead of in the north. These areas were selected as being those least likely to suffer from the threatened famine, and the experience of the year shows that no better tracts could have been chosen. In addition to the above a detachment under Mr. E. F. Berkeley was employed in district Noákháli (*a*) in the traverse and cadastral survey and in the record writing of certain Government estates in the islands of Sandip and Hatiya; (*b*) in the traverse and topographical survey on the 16-inch scale of other Government estates; and (*c*) in the traverse and topographical survey on the 2-inch scale of the remaining portions of the islands of Sandip and Hatiya, as well as of the other islands and new accretions at the mouths of the Fenny and Meghná rivers. A traverse surveyor under the immediate control of Captain Crichton himself was also sent to Midnapore, with a view to surveying and writing the records of 14 villages of the Majnamutha Estate, as a test of the accuracy of the old maps and records of that estate prepared by Mr. J. C. Price in 1875; this was required in order to decide whether the old maps were capable of revision or whether a new survey would be necessary.

259. It having been decided that the Bihár survey parties should be reduced from four to two cadastral sections, it was proposed by the Government of Bengal and sanctioned by the Government of India, *vide* letter No. $\frac{1368}{40\text{-}8}$, dated 3rd June 1896, that Captain Crichton should, in addition to his administrative duties as Superintendent of Settlement Surveys in Bengal, take over the executive control of the Bihár surveys, and that his head-quarters should be transferred from Calcutta to Bihár. Captain Crichton accordingly took over charge of the survey party from Captain Symonds on the 30th October 1896, that officer remaining as his assistant in charge of the traverse section. Captain Symonds also held charge of the party from the 12th February to the 17th March, when Captain Crichton was forced to take privilege leave owing to ill health.

260. As was the case in previous years the survey establishments have been utilised as part of the Settlement Department. The same *amin*, who surveys

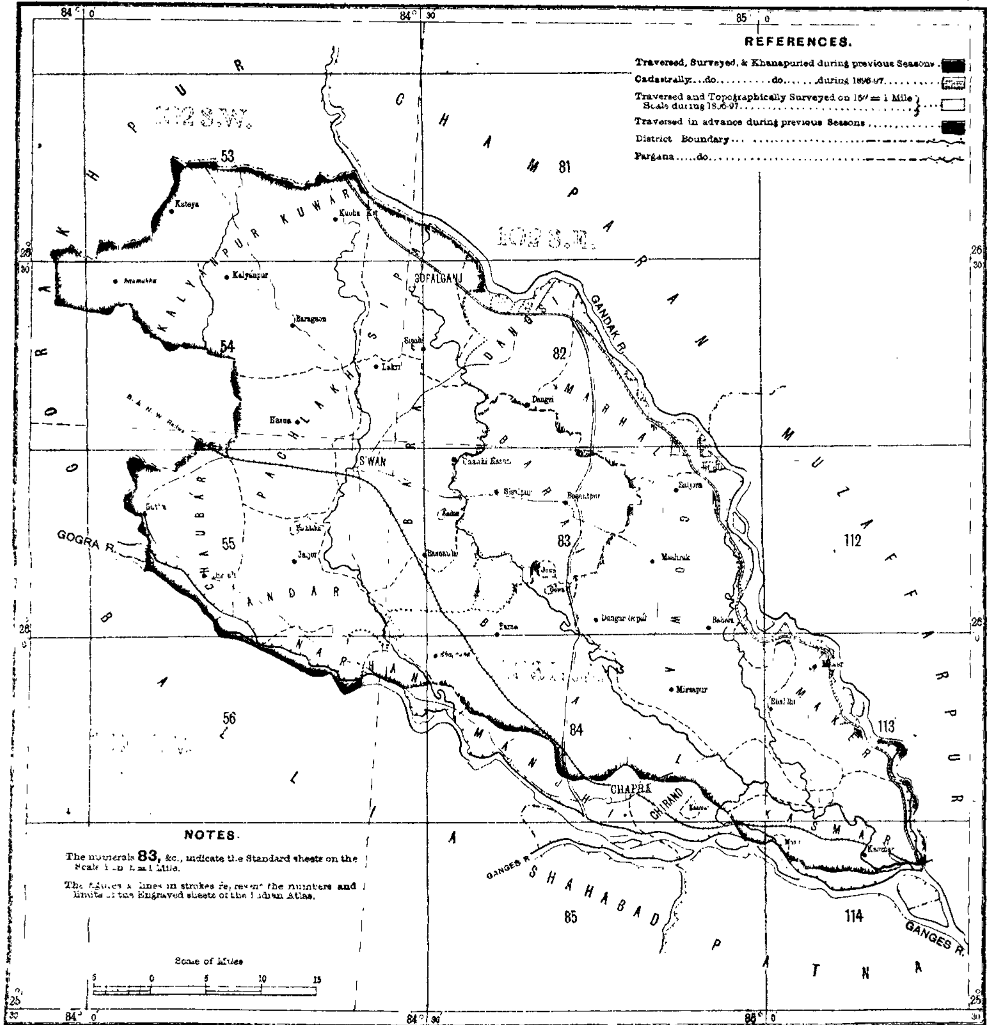
* The officer in charge reports that Mr. Connor and all the European assistants have worked well, and that amongst the Native Establishment the names of Babu Bhagobutty Charan Chuckerbutty and Pandit Kedar Nath have been brought to special notice, whilst the following have done excellent work.:—Tufail Ahmed, Mohamed Nisar Ali, Harput Rai, Tajammal Aly, Bhikam Chand, Pandraju, Rohan Lall, Ram Sarup, Rafaulla, Skrikristo Chatterjee, Bachai Khan, Shib Lall, Surfraz Khan, and Abdul Saqur.


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BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTRICT SARAN.

1896-97. No. 4 PARTY.



No. 459-S. 97.

a village, writes the *khânápuri* thereof under the supervision of the Settlement Department, assisted by the inspectors of the Survey Department. During the recess season the same *amin* extracts one set of the field areas of the village surveyed by him and completes, with the aid of his *moharrir*, all the village records and statistics. No areas have been extracted in the field, it having been proved, by an experiment made last year, to lead to inaccuracy and to add considerably to the expense without any corresponding advantage.

261. For the temporary demarcation of village boundaries, notices in duplicate for every village were sent to the Collectors of districts who distributed them. In these notices the inhabitants were directed to mark every salient angle on their boundaries with a bamboo staff and small earthen mound. As a rule, the demarcation has been very fairly done, and it generally followed the limits of the revenue survey *mauza*, but in certain cases it followed the limits of existing *mauzas*, *i.e.*, in cases where the revenue survey *mauza* had been divided into two or more portions, each portion was demarcated as a separate village. All theodolite stations, whether actually on the village boundary or not, have been permanently marked, except in *diára* tracts, or on disputed boundaries. Receipts on printed forms for all permanent marks were taken from the *zamindárs* and other parties concerned, and as a further safeguard all such marks were covered over with small mounds of earth.

262. Except in the Government estates in Noákhálí, all village sites were surveyed in detail on the scale of 64 inches=1 mile.

263. During the year under report the procedure in dealing with lands liable to flooding by river action has been altered. The main difficulty was to arrive at a line which would, with fair accuracy, define villages subject to river action from those not so subject, more especially so as in many cases only a portion of a village is affected. It was eventually decided that all *diára* lands should be traversed, and that a surveyor should pass over the ground and mark on a skeleton map on a small scale the approximate position of the line separating fields which have permanent boundaries from the true *char* lands. On the riverside of the line thus arrived at, all villages entirely or partly belonging to Government were to be cadastrally surveyed in the ordinary course, and villages entirely permanently settled or temporarily settled, but not the property of Government, were to be only topographically surveyed on the 16-inch scale.

264. No labour has been supplied free of charge in any of the districts in Bengal during the past season. Besides his chainman on fixed pay of R4 per mensem, each *amin* is allowed 3 coolies while employed on survey. In districts Sáran and Darbhanga coolies were obtainable everywhere at 1½ annas each per diem, but in Midnapore 2 to 3 annas had to be paid to each cooly. In Noákhálí no coolies could be obtained, and *khalásis*, on fixed pay, had to be provided.

265. During the field season the health of the survey establishments was very good. In the islands of Noákhálí there was an epidemic of cholera, but the establishment did not suffer therefrom, only one *amin* dying of cholera; the *khalásis*, however, suffered a good deal at the end of the season from fever and dysentery.

266. The head-quarters of the Bihár survey and the traverse section recessed at Mussooree. The Sáran and Darbhanga sections recessed at Dígna near Dinapore, whilst the Noákhálí detachment recessed at Dacca.

SURVEY OF THE SÁRAN DISTRICT.

267. *Traverse Survey.*—The traverse survey in this district was commenced on the 25th October 1896, and closed on the 18th March 1897, when the section moved up to Mussooree to its recess quarters. The whole of the area traversed is *diára* land on the Gandak river and was contained in one river circuit which was sub-divided into 7 sub-circuits, each sub-circuit containing from 14 to 15 villages. The total linear miles of chaining amounted to 189 miles. Two chains of 100 and of 93 links respectively were used on the river and sub-circuits, the results being compared on the spot. Only one chain was used on the village circuits. The angular work was checked by two star azimuths and the bearings and azimuths of the adjoining traverses. No permanent marks were put up, as the entire area is *diára* land; only pegs were used. The cost rate is R89·3 per square mile.

268. *Cadastral survey and writing of records.*—The cadastral operations were confined to the Basantpur Thána and to a strip of *diára* land along the Gandak river and in Thána Gopálganj. Field work was not commenced until the 25th November, owing to the uncertainty as to the programme which would be finally approved of by the Bengal Government. The programme eventually sanctioned was a very small one, but, as field work commenced late and it was necessary to close work early on account of the threatened scarcity, sufficient employment was found for the full strength of the section. It closed field work and moved into recess quarters at Dinápore on the 29th March.

269. The area surveyed which lies in Thánas Basantpur and Gopálganj is mapped on 363 sheets on the 16-inch scale, and in addition there are 218 sheets on the 64-inch scale on which village sites have been mapped. The average size of the field in Thána Basantpur is a little under 0·32 of an acre and in Thána Gopálganj 0·70 of an acre; the larger size of the field in Gopálganj is due to the villages there being *diára*. To check the survey 656 linear miles were chained by European officers or by independent *partáls*, and 563 linear miles by inspectors. The number of entries checked in the field records by European officers was 3,924 and by inspectors 102,900, which gives an average of 26 per cent of the whole number of fields. The cost rate for detail survey is R142·03 per square mile and for record writing R128·62. The *raiyats* on the whole showed great interest in the operations and were always anxious to obtain their *parchas*; the attendance during the survey stage was, however, as usual very indifferent.

270. *Topographical survey.*—In accordance with the orders of the Bengal Government, the *diára* lands were surveyed on the 16-inch scale; all topographical details of importance were carefully surveyed and extensively checked. Nearly the whole of the *diára* tract, which occupied 24 entire villages and portions of 31 others, was under temporary cultivation. The village sites were surveyed on the 16-inch sheets in blocks only not in detail. The cost rate of this work is R55·48 per square mile.

271. The areas of work completed are given in the following table:—

District.	Traverse Survey.		Cadastral survey, 16 inches=1 mile and Record writing.			Topographical survey, 16 inches=1 mile.
	No. of stations.	Area in square miles.	No. of villages.	No. of fields.	Area in square miles.	Area in square miles.
Sáran . .	765	60·1	324	412,843	209·6	25·2

272. The area remaining for traverse survey in Sáran is 168 square miles and for cadastral and topographical survey 1,190 square miles.

Survey of the Darbhanga District.

273. *Traverse Survey*—After a delay of 3 weeks, caused by the doubt as to where the traverse section was to work, sanction was received to commence in the southern portion of the district in Thánas Dalsingh Sarái and Mohamdinagar. The area in the former consisted almost entirely of *diára* lands on the Ganges river, the plots of which were required at once for detail survey. The whole area traversed was comprised in one river and two main circuits, which were again sub-divided into 21 sub-circuits. Each sub-circuit contains on an average 22 villages.

274. The total number of linear miles chained amounted to 1,745. As in Sáran, two chains were used on the main and sub-circuits and only one on the village circuits. Two stations of the Great Trigonometrical survey were connected with to check the chaining. The angular measurements were checked by 42 star azimuths. Of the 8,608 new stations, 705 were trijunction points and were marked by stones and large glazed cylinders 8-inches in diameter. Along village boundaries 6,642 stations were marked by clay cylinders 2-inches in diameter. The remaining 1,261 stations being in the *diára* tract or on

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTRICT DARBHANGA.

1896-97. No. 4 PARTY.

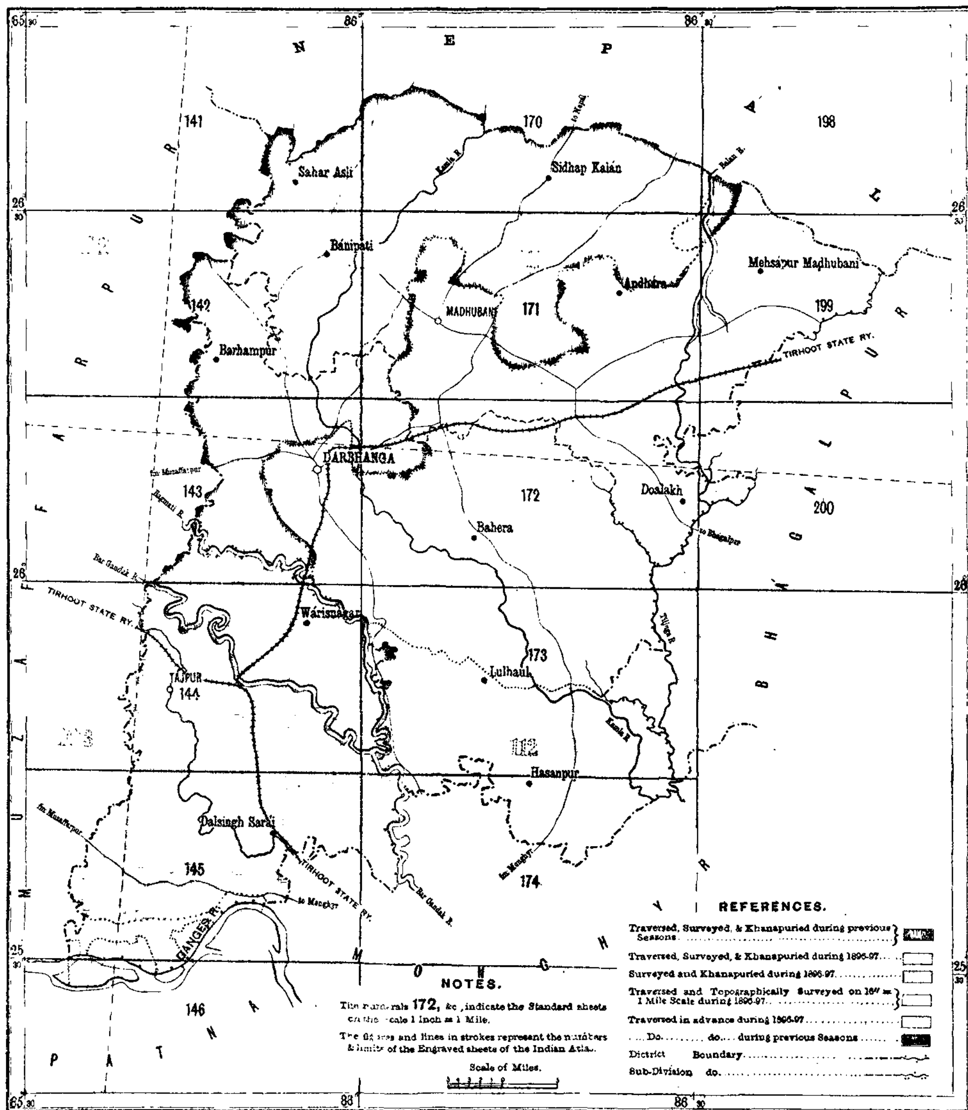


Photo S. I. O., Calcutta

No. 458-S. 97.

BENGAL SURVEY.

INDEX TO THE CADASTRAL & TOPOGRAPHICAL SURVEYS IN DISTRICT NOAKHALI.

1896-97. DETACHMENT.

91° 0′ 91° 30′

23° 15′ — T I P P E R A — 126 S.W. — 126 S.E.

382 396 405

to Chandpur, to Comilla, from Comilla, Subar, Anjud, Kalir, Chhagalnaia, Ramganj, Bhimpur, Kalodi, Daulatpur, Diwanganj, Raipur, Nandirgaon, Meghna R., FENNY, Begamganj, Amirgaon, Lakhimpur, Mahabatpur, Bhulloouh, Joykishtopur, Shanapur, to Chittagong, Goripur, Companyganj, NOAKHALI, Jagdananda, Bamni

23° 0′ — 383 397 406

45′ — B A C K E R G U N G E — C H I T T A G O N G

Bamni R., Badur Char, Sandip Channel, Luker Char, Ram Gotar, Gaiti Char, Hattia R., Kalapania, Hattia, Haroni, Sandip, Mosapur, Islampur, Shahbazpur R.

384 398 407

30′ — 385 399 408

127 N.W. 127 N.E.

22° 15′

REFERENCES.

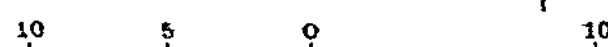
Traverse and Cadastral Survey, 16 Inches = 1 Mile. Season 1896-97	
Traverse and Topographical Survey, 16 Inches = 1 Mile. Season 1896-97	
Traverse and Topographical Survey, 2 Inches = 1 Mile. Season 1896-97	
District ...... Boundary	
Sub-Division .... do	

NOTES.

The numerals 397, &c. indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

The figures & lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas.

Scale of Miles



91° 0′ 91° 30′

disputed boundaries have been marked by pegs only. The cost rates are R0·50 per square mile for marking stations and R54·34 per square mile for traversing.

275. *Cadastral survey and writing of records.*—The tract sanctioned for detail survey was comprised in Thánas Tájpur and Dalsingh Sarái in the south of the district, where the effects of the famine were not appreciably felt during the field season. The area surveyed is mapped on 976 sheets on the 16-inch scale and on 328 sheets on the 64-inch scale showing village sites. The average size of the field calculated on the whole area surveyed is 0·32 of an acre, but in the *diára* villages on the Ganges river it is 0·86 of an acre. The detail survey was checked by 863 linear miles of test survey run by Europeans and by independent *partáls* and by 1,398 by inspectors. The number of entries checked in the field records by European officers was 8,016 and by inspectors 214,939 which gives an average of 20·4 per cent of the whole number of plots. The cost rates are:—For detail survey R78·31 and for record writing R87·47 per square mile. In this district the inhabitants gave considerable trouble at the commencement of operations; no active opposition was offered, but there was much difficulty in inducing the people to attend whilst the survey was being made.

276. *Topographical survey.*—The area topographically surveyed comprised 23 villages and has been mapped on 53 sheets on the 16-inch scale. The villages were surveyed in block only in their proper positions and not on separate sheets in detail. It was checked by 146 linear miles of chaining; the cost rate is R27 per square mile.

The areas completed are given in the following statement:—

District.	Traverse survey.		Cadastral survey, 16 inches=1 mile and record writing.			Topographical survey, 16 inches = 1 mile.	
	No of stations.	Area in sq. miles.	No. of villages.	No. of fields.	Area in sq. miles.	No. of villages.	Area in sq. miles.
Darbhanga	8,608	416·6	638	1,091,765	545·0	23	40·2

277. The area remaining for survey is as follows: For traverse survey 1,119 square miles and for cadastral survey 2,632 square miles. The *diára* tract is completed, and there is therefore no area remaining for topographical survey.

Survey of the Noákhálí District.

278. The work in this district consisted of three kinds, *viz.*, (*a*) the cadastral survey and record writing of certain Government estates in the islands of Sandip and Hátiya; (*b*) the topographical survey on the 16-inch scale of other Government estates; and (*c*) the topographical survey on the 2-inch scale of the remaining portion of Sandip and Hátiya as well as of the other islands and new accretions at the mouths of the Fenny and Meghná rivers. The traverse surveys for all these operations had also to be done, none having been made in advance, and during the recess a map on the 4-mile scale had to be compiled in order to test the additions and corrections made on the district map by the local authorities.

279. Anticipating difficulties with the inhabitants who were described as being of a sensitive and turbulent character, the Director of Land Records requested that the native agency should consist as far as possible of Bengalis; the greater portion of the establishment was therefore recruited locally and from passed students of the Dacca Survey School; a few expert surveyors (not local men) only being employed on the more intricate portions of the work such as the astronomical observations and triangulation. Field work commenced on the 7th December and closed on the 25th May, on which date the detachment went into recess quarters at Dacca.

280. Fortunately the anticipated opposition was not experienced; on the contrary great attention and interest were displayed in the survey operations, still the difficulties in surveying the islands of this district have been very great; the work was very scattered, provisions and especially drinking water were hard to procure; local chainmen were very difficult to get, and when obtained they did not perform a fair day's work, whilst towards the end of the season communication

amongst the southern islands was difficult on account of the roughness of the sea. The health of the establishments was on the whole fairly good; though cholera was very prevalent in Sandip and Hátiya only one *amin* died. During April and May there was a water famine which brought on a good deal of dysentery and fever.

281. *Traverse Survey.*—There were no village boundaries within the Government estates which were to be cadastrally surveyed, and as several of the estates were too large to be retained as the unit for the cadastral survey, it was decided to divide them into blocks averaging from one to two square miles in area. There were 44 such blocks which were sub-divided by 54 cross traverses. The total linear miles of chaining was 264·6. Two chains were used throughout. Of the 1,003 traverse stations, 149 were permanently marked by glazed clay cylinders and 200 by locally made clay cylinders; the remaining stations in lowlying and unimportant positions have been marked by pegs only. The cost-rates are R2·50 per square mile for marking stations and R32·06 per square mile for traversing. The unit of the traverse survey for the 16-inch topographical work was the estate or *char*; interior villages were not traversed separately: these *chars* are all Government estates. The number of linear miles of new chaining amounted to 128·4 and the number of new stations was 360. The cost-rate is R8·28 per square mile. For the 2-inch topographical survey the unit was the island. No village boundaries were travesed, as they were not required for the topographical survey. The area consists of private and permanently settled estates. The linear miles of chaining amounted to 217, including triangulation and lines connecting islands and the stations of the Great Trigonometrical Survey. There were 689 new stations, all of which were marked by pegs. The cost rate is R4·64 per square mile.

282. *Cadastral survey and writing of records.*—The area cadastrally surveyed has been mapped on 109 sheets on the 16-inch scale The homestead lands were also surveyed on the same scale in their true position and no enlargements were necessary to enable the numbering to be entered. The average size of the field or survey number was 1·11 acres. In the area surveyed 153 linear miles of check survey were run by the officer in charge or by independent *partáls* and 239 miles by inspectors. The number of entries in the records checked by the survey inspectors was 9,760 and by the officer in charge and the Settlement officers 2,567, which together represent 25·5 per cent of the total number. The cost per square mile for detail survey is R 9 per square mile and R58·49 per square mile for writing the records.

283. *Topographical survey on the 16-inch scale.*—The area of this class of survey was 145·5 square miles, all Government estates. The boundaries of these estates have been mapped in the same detail as in cadastral surveys, offsets being taken from the traverse lines. All village sites, streams, tanks, roads and other topographical items have been surveyed; the limits of cultivation have been shown on the maps. The mapping is comprised in 149 sheets. The accuracy of the survey was tested by 54·7 linear miles of check survey by inspectors and independently. The cost rate is R12·28 per square mile.

284. *Topographical survey on the 2-inch scale.*—The area completed on this scale was 198·8 square miles and the mapping is comprised in 12 sheets. The boundaries of estates were not required and were not therefore surveyed. All topographical items, including the limits of cultivation, were entered. The cost rate is R5·96 per square mile.

285. The following statement gives the areas surveyed:—

THÁNA.	TRAVERSE SURVEY.	CADASTRAL SURVEY, 16-INCH SCALE, AND RECORD WRITING.			TOPOGRAPHICAL SURVEY.	
					16-INCH	2-INCH
	Area in sq. miles.	No. of blocks.	No. of fields.	Area in sq. miles.	Area in sq. miles.	Area in sq. miles.
Sandip	214·1	28	37,254	51·5	47·0	118·9
Hátiya	184·0	15	11,088	32·5	85·8	65·7
Noákhálí	17·0				2·8	14·2
Ráipur	9·9				9·9	...

The outturn of the season has fallen short of the programme on account of exceptional difficulties already alluded to, and there remains an area of 9·5 square miles for cadastral survey, of 39 square miles for 16-inch topographical survey and 3 square miles for 2-inch topographical survey.

SURVEY IN THE MIDNAPORE DISTRICT.

286. In this district the survey and writing of the records of 14 villages were undertaken with a view of judging of the value of the old maps and records of the Majnamutha and Jalamutha estates which had been prepared by Mr. J. C. Price in 1875. The programme was afterwards reduced and only 8 villages were surveyed. The old maps having been prepared on the 32-inch scale, the new survey was made on the same scale. The following statement shows the results of the new survey as compared with the old :—

NAME OF VILLAGE.	AREA IN ACRES.		NUMBER OF FIELDS.	
	Old survey.	New survey.	Old survey.	New survey.
Mahi Sagot	132	189	1,280	832
Bamunia	516	587	2,136	1,508
Gopál Chak	229	214	2,031	1,050
Hirukala	35	23	152	183
Chauiti	329	326	1,682	1,524
Darmat	659	653	2,412	2,420
Chak Gobindabera	69	72	527	166
Bonomálichatta	37	42	180	177
TOTAL	2,006	2,106	10,400	7,860

287. After a careful comparison of the new with the old maps, which were based on magnetic compass traverses, the Superintendent of Settlement Surveys is of opinion that an entirely new survey and an entirely new record should be made. The Board of Revenue agree with the Superintendent and have recommended to the Government of Bengal that a new survey should be undertaken of the Majnamutha and Jalamutha estates.

288. The following statement shows the amount of survey work remaining to be done in North Bihár :—

DISTRICT.	Traverse survey.	Cadastral survey and writing of records.	Diára Topographical survey.
	Square miles.	Square miles.	Square miles.
Sáran	180	1,090	100
Darbhanga	1,119	2,632	...
TOTALS	1,299	3.722	100

Under the orders of the Government of India, letter No. $\frac{1368}{30\text{-}6}$, dated 3rd June 1896, the above is to be completed by one traverse camp and two cadastral camps by the end of September 1900. About half will therefore be completed during the coming field season. In addition to the above certain portions of the boundary

between Nepál and the districts of Purnea and Bhágalpur are to be relayed, and the resurveys of the Majnamutha and Jalamutha estates as well as the survey of the Balarámpur estate, all in Midnapore district, are to be completed. The small remaining areas in Noákhálí are also to be completed. No orders for surveys in Bengal other than the above have at present been issued.

289. The Superintendent of Settlement Surveys reports that Captain Symonds, who was in charge of the North Bihár traverse section, and for a time acted for him as Superintendent of Settlement Surveys, Bengal, has given him entire satisfaction in the performance of his duties.*

THATÔN, PEGU AND TOUNGOO DISTRICTS, LOWER BURMA.

NO. 7 PARTY.

Personnel.

Mr. B. G. Gilbert-Cooper, Officiating Deputy Superintendent, 1st grade, in charge up to 4th September 1897.			
„ W. C. Price, Extra Assistant Superintendent, 2nd grade, in charge from 5th September 1897.			
„ G. W. Jarbo, Extra Assistant Superintendent,		4th	grade.
„ J. S. Swiney, „	„	5th	„
„ M. Gastaud, Sub-Assistant	„	1st	„
„ T. W. Babonau „	„	1st	„
„ J. H. Murphy „	„	2nd	„
from 1st December 1896 to 16th September 1897.			
Babu Amar Singh, Sub-Assistant Superintendent,		2nd	„
„ Abinash Chunder Bose, „	„	3rd	„
Mr. C. S. Littlewood, „	„	3rd	„
from 15th November 1896 to 26th June 1897.			
22 Sub-Surveyors, etc., and 140 temporary Field Surveyors, Inspectors, etc.			

290. During the year under report the charge of this party was held by Mr. B. G. Gilbert-Cooper, who was, however, temporarily relieved by Mr. W. C. Price on the 5th September 1897, on his availing himself of privilege leave.

291. The party was divided into 3 sections as follows:—

Section No. 1 (traverse and cadastral combined) under Mr. J. S. Swiney, operated in the Pyuntaza and Zeyawadi townships of districts Pegu and Toungoo respectively, commencing field work on 8th December 1896 and closing on the 30th June; a detachment from this camp under Mr. M. Gastaud, was deputed for the topographical survey on the 2-inch scale of 452 square miles in district Thatôn, to complete standard sheets Nos. 372 and 326, and commenced work on 9th November 1896 and closed on 14th May 1897; Section No. 2 (cadastral), under Mr. W. C. Price, began work on the large scale survey (50 feet and 100 feet=1-inch) of the town of Rangoon, on the 13th November 1896 and closed field work on 5th June 1897; section No. 3 (traverse), under Mr. G. W. Jarbo, started traverse operations in Rangoon on 2nd November 1896 and closed field work on 31st May 1897. On the completion of the traverse work in Rangoon, this section was transferred to take up the advance traverse of district Toungoo on 15th January 1897.

292. The programme of the field season consisted of:—

(*a*) *Traversing.*—Pegu district, 8 square miles, in Ananbaw Circle (1-inch sheets 322 and 323). Toungoo district, 600 square miles in circles Kwindala, Kyaukhmaw and Kyaukkyi. Rangoon town 2·7 square miles, exclusive of water area.

(*b*) *Detail Survey.*—Pegu district, 374 square miles, on 16-inch scale, in Ananbaw and Yèhla Circles, to complete the district. Toungoo district, 150 square miles, on 16-inch scale, in Kwindala and Kyaukhmaw Circles (1-inch standard sheets Nos. 322 and 323). Rangoon town large scale surveys on 50 and 100 feet to the inch as follows:—

2·4 square miles on the scale of 50 feet=1 inch
3·9 „ „ 100 „ „
exclusive of water area.

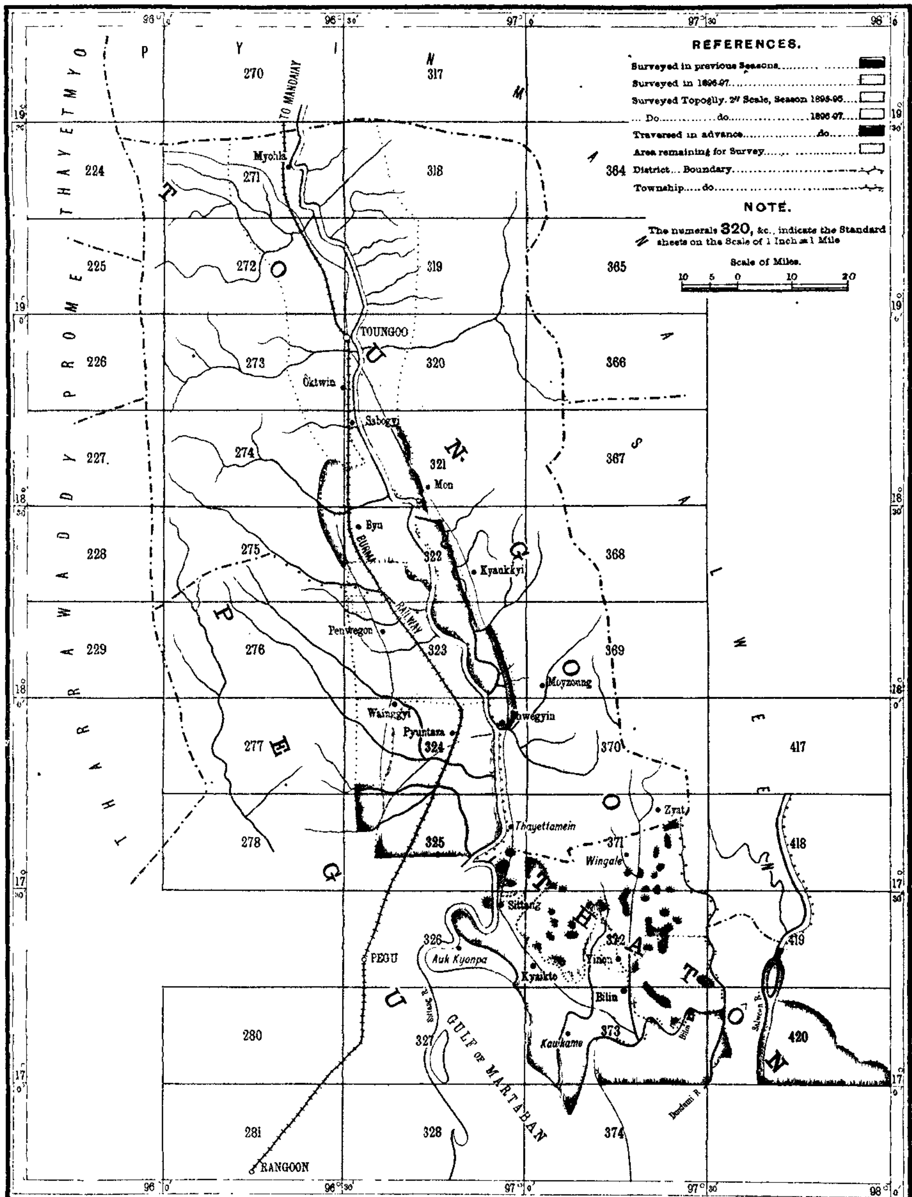
(*c*) *Topographical Survey.*—Thatôn district, 480 square miles, to be triangulated and topographically surveyed on 2-inch scale in

* Messrs. A. W. Smart and C. S. Kraal, in charge of cadastral sections have done excellent work during the year under report. The former has added to his reputation as an exceptionally able revenue surveyor. The junior assistants, Mr. C. S. Gasper and Babu Nilmoni Chatterjee, have afforded very valuable aid to the officers in charge of their sections. Mr. E. F. Berkeley, in charge of the Noákhálí detachment, has done very well in an exceptionally difficult survey.

BURMA SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTS. THATON, PEGU, & TOUNGOO.

1896-97. No. 7 PARTY.



Reg. No. 480, S. I. D.—Dec. 97.—550.

Photo. S. I. O. Calcutta.

No. 473-S. 97.

standard sheet No. 372. Also 30 square miles on 2-inch scale in sheet No. 325, total 510 square miles.

293. The demarcation was well done, both in Pegu and Toungoo districts. At the commencement of the season it was found that the demarcation was somewhat in arrears, owing to large portions of the area to be demarcated being under water; but this was remedied later in the season by the temporary employment of 3 additional demarcation officers, and the work of survey did not suffer in any way.

294. The following statement shows the season's outturn exclusive of goon Town Survey :—

Localities.	Traverse Survey.		Cadastral Survey, 16-inch=1 mile.		
	No. of *kwins.*	Area in square miles.	No. of *kwins.*	No. of fields.	Area in square miles.
Pegu	295	11	188	209,490	450
Toungoo		679	20	73,680	59
		Topographical Survey 2-inch=1 mile.			
Thatôn		21 11 (*a*)	... ...	... ...	452 41 (*a*)
Total		722	208	283,170	1,002

(*a*) Resurvey of Sittang river owing to changes.

295. In the Thatôn district, 21 square miles of forest reserve was traversed, and also 11 square miles of river area. In district Pegu 11 square miles were thus surveyed in order to complete the district; and in district Toungoo, 679 square miles of advance traverse was effected. The total area traversed being 722 square miles, embracing 295 *kwins* or villages. The theodolite was set up at 14,888 stations and 2,336 linear miles of double chaining was done. This work was checked by 150 astronomical observations for azimuth. Owing to facilities for carriage, clay cylinders were used throughout for marking the stations.

296. The detail operations on the 16-inch scale in the Pyuntaza township, Pegu district, were checked by 1,244 linear miles of chain measurements, of which 447 were done, partly independently after the sheets had been received in office, and partly by European assistants. The proportion of cultivation to jungle is as 2 to 3 and the average size of the field is 0·56 of an acre, calculated on the cultivated area only. This completes the cadastral survey of the Pegu district.

297. The 16-inch detail operations in the Toungoo district were checked by 328 linear miles of chain measurements, of which 125 were done partly by independent *partáls* and partly by European assistants. The proportion of cultivation to jungle is as 2 to 3, and the average size of the field is 0·44 of an acre, calculated on the cultivated area only.

298. In addition to the above new survey, 58 villages of district Thatôn were revised owing to representations of the Settlement Officer that large extensions of cultivation and alterations in field limits had taken place, particularly in the areas under sugar-cane cultivation.

299. Topographical operations on the 2-inch scale were undertaken in district Thatôn of areas both within and outside the limits taken up cadastrally, in order to fill up standard sheets Nos. 372 and 326. The boundaries of the Onkagyu and Pilkagyu forest reserves, which fell within the area under topographical survey, were taken up and traversed with the theodolite.

300. The total expenditure for the year, inclusive of the Rangoon town survey charges, was R1,98,796, including a charge of 4 per cent for instruments.

The cost rate of the traverse operations in districts Thatôn, Pegu and Toungoo was R63-14-2 per square mile, and the cost rate of detail 16-inch survey in districts Pegu and Toungoo was R150-13-10 per square mile. The cost rate of revision survey in district Thatôn was R35-3-2 per square mile. The cost rate of the topographical work in district Thatôn on the 2-inch scale was R45-10-5 per square mile.

301. The country under traverse and cadastral survey this year was very unhealthy, and retarded the work considerably. The area topographically surveyed was more difficult than last year, and was all surveyed on the 2-inch scale, whereas last year more than half the area returned was done on the 1-inch scale.

302. The season's detail 16-inch work is mapped on 588 sheets in district Pegu, and 62 sheets of district Toungoo. The whole of the sheets of the Pegu district will be completed by the end of the recess season, and will be sent to Calcutta for publication as soon as they have been passed by the Settlement Officer. The sheets of the Toungoo district will also be ready for publication by the end of the recess season. The tracings and area statements of the 188 villages of district Pegu are nearing completion, and will be ready for despatch to the Settlement Officer by the commencement of the field season.

303. The 2-inch mapping of sheets Nos. 326 N. E., 373 N. W., and 372 N. W., has been completed; and it is expected that the remaining sheets Nos. 372 and 373 N. E. will be completed by the close of the recess season.

304. Dysentery and fever were very prevalent amongst the *khalásis* working in the Pegu and Toungoo districts; nearly ⅕th of the menial establishment being incapacitated for work throughout the field season from these causes, one man died of cholera, and two from fever: a considerable number had to be sent to their homes before the close of field operations. The health of the assistants was good, with the exception of that of Messrs. Babonau and Littlewood, who suffered much from the above mentioned causes.

305. The number of Burmans and Karens employed this year in the detail survey was 56. Of these, 3 inspectors and four field surveyors were already in possession of the five years certificate; one field surveyor had qualified for a certificate under the two years scheme during the previous year; 7 men have served 5 years, and 1 man three years outside Mr. Bridge's scheme; 6 men joined from parties working in Upper Burma; 16 men were apprentices in this party during last season, and were taken on the strength this season; and 15 men, volunteers from the survey schools in Burma, were entertained to undergo a survey training under the two years scheme. The average monthly earnings of the Burman field surveyors is R36-6-0, and those of the Hindustani surveyors for the same period R49-15-9 The 3 inspectors did their work well: one of these men Moung Po Chôu was deputed, with the sanction of the Local Government to take up one of the temporary posts of demarcation officer, in which capacity he gave entire satisfaction. The older Burman field surveyors worked well; but this cannot be said of the 15 new men, who joined this year from the local survey schools: out of these, 7 only have qualified for a bonus, and of the remainder, 4 failed to earn the bonus, 3 absconded, and one left under the plea of illness.

306. The programme of the party for the coming field season consists of:—

Traversing Toungoo District to complete the district, giving an area, so far as can be ascertained at present, of 800 square miles in circles Kyaungbya, Sethlèdaung, Zeyawadi, Pauktaw, Tetpyauk, Kaungyan, Tantabin, Dinnyawadi, Dwayawadi, Yegyi, Lèhla, Bahnaung, Kanni, Kèlin, Swa, Kunôn, Thagaya, and Myohla, should the area remaining to be completed exceed this estimate, it will be possible to complete 1,000 square miles in the season.

Detail Survey Toungoo District, 800 square miles on 16-inch scale in circles Kyaungbya, Sethlèdaung, Kyaukkyi, Kyaukhmaw, Môn, Bônmadi, Tantabin, Minbôn, Zeyawadi, Tetpyauk and Kaungyan.

307. Thanks are due to the Deputy Commissioner of Pegu, Mr. W. N. Porter, the Deputy Commissioner of Toungoo, Mr. T. C. Mitchell, and to the Deputy Commissioner of Thatôn, Mr. R. C. M. Symns for the cordial assistance rendered by them to the Survey Department during the past year.

Rangoon Town Survey.

308. The traverse operations of the large scale Rangoon Town survey were continued this year on the 2nd November, and brought to a conclusion under the immediate supervision of Mr. Jarbo, on the 15th January. The out-turn consisted of 7 sub-circuits, 87 blocks and 476 *purdahs*, covering an area of $5\frac{1}{4}$ square miles, of which half is water area. In effecting this, the theodolite was set up 2,580 times in only 96 linear miles of chaining. The traverse stations in the town proper are marked by small iron pegs driven into the ground, and in the suburban portion, by clay cylinders embedded flush with the ground, and an iron peg driven into the centre. The total cost of the traverse work only was R5,267 inclusive of 4 per cent for instruments, giving a rate of R1,003-3-9 per square mile. Two-thirds of the levelling operations in the town having been completed last year, the remainder was finished by the 15th January, 24 linear miles of chaining being done, staff readings were taken at 538 points, and 78 bench-marks were established at the corners of streets, on walls of culverts, parapets, etc. The records in connection with this work have been completed. The total cost amounted to R2,035, giving the rate of R27-8-0 per linear mile.

309. The detail survey of Rangoon was continued on 13th November and was finished on 5th June. Rather more than half was completed last year, and the remainder 5·96 square miles, was disposed of this year and mapped on 166 sheets, *viz.*, 1·38 square miles on the scale of 50 feet = 1 inch mapped on 68 sheets, and 4·58 square miles on the 100 feet scale mapped on 98 sheets. The total cost of the detail survey was R33,786, giving the rate of R12,334-0-11 per square mile for the 50 feet scale, and R3,660-7-8 per square mile for the 100 feet scale. As the demarcation officer was unable to demarcate the lots in town block C on the 50 feet scale, owing to the original Municipal plan of this block having been surveyed on the 10 feet scale, at the request of the Municipality, this block was surveyed on the 10 feet scale instead of on the former scale. In order to avoid a break in scale for so small an area, a field book record of each measurement was kept, which was subsequently utilized for plotting this block on the 50 feet sheets; thereby avoiding the necessity of pentagraphing it down to the 50 feet scale. The area of this block has therefore been included in that shown above as having been done on the 50 feet scale.

310. Approximate contours five feet apart have been run over the undulating portion covering an area of about five square miles.

311. Every sheet surveyed during the season has been well checked, in effecting which 967 lines = 82·9 linear miles were run by European assistants, 367 lines = 16·5 linear miles by native inspectors, and 122 lines = 5·4 linear miles by independent check *partáls*.

312. Of the 166 sheets comprising this season's work, the whole have been inked in, and working tracings have been made for the Municipality in addition to special field books of each sheet, together with all the area statements which were made over to the Boundary Officer. All the sheets of the wall map on the scale of 300 feet = 1 inch, 22 in number, exclusive of blank sheets, have been prepared. A map of Rangoon on the scale of 1,000 feet = 1 inch has been asked for, and is being compiled for the Municipality. The cost (R250) will be separately borne by the Municipality.

313. The total expenditure for the year on the Rangoon town survey was R37,635, which, together with the expenditure last year (R64,966), and adding 4 per cent for instruments, bring the total expenditure up to date to R1,06,705. As was anticipated last year the original sanctioned estimate for the town survey (R83,600) was insufficient for the work to be undertaken, chiefly on account of the cost rate for the portion surveyed on the 100 feet scale (covering $\frac{2}{3}$rds of the total area to be surveyed) having been very much underestimated; this was due to the fact that there were no previous surveys on that particular scale on which to form an estimate. The estimate for this scale of work was originally put down at R2,000 per square mile; but actual experience has shown it to amount to about R5,000 per square mile. The estimate for the 50 feet scale survey being based on the cost rate of the Calcutta survey, proved to be very accurate. As it was therefore clear that the total allotment originally

sanctioned for the work (R83,600,) would be considerably exceeded, a revised estimate was prepared, and an additional grant was obtained from the Municipality of R34,990 to enable the work to be completed by the end of November 1897.

314. All the triangulated stations in Rangoon, except those on the roofs of houses, were permanently marked by masonry pillars 1½ feet square, and 4 feet in depth, built at the request of the Municipality, 3 feet being sunk below the surface of the ground and 1 foot above. These (13 in all) were handed over to the Municipality for preservation, and were separately paid for.

315. The conduct of the men employed on the town survey was excellent throughout, and there was not a single complaint made against any subordinate of the survey during the year. Cordial relations were maintained throughout with the officers of the Municipality, who rendered every assistance in their power; in connection with which the name of Mr. Shircore, the Registrar of town lands, should be mentioned. His knowledge of the town and readiness to supply information being of the greatest assistance.

316. The Deputy Surveyor-General inspected the party from 12th January to 16th idem, and again on his return from Upper Burma from 6th February to 14th idem: during these visits the whole of the records and accounts of the office of the Deputy Superintendent, together with those of the 3 camp offices, were thoroughly examined, and the arrangements for carrying on the large scale survey of Rangoon town were fully explained to the Deputy Surveyor-General. Colonel Sandeman also personally checked the field work of the town in several localities selected by himself, and expressed himself as thoroughly satisfied with the minute accuracy of the field work. The Officiating Deputy Surveyor-General, Lieutenant-Colonel Hobday, also inspected the party, in recess, on the 9th and 14th July.*

NORTH-WESTERN PROVINCES AND OUDH.

317. Cadastral survey and record-writing operations were continued in these provinces under the superintendence of Mr. G. B. Scott, Superintendent of Land Records Surveys, in the following districts :—

North-Western Provinces.—Meerut, Sháhjahánpur and Lálitpur Sub-division.

Oudh.—Bahraich, Kheri and Sítápur alluvial *mahals.*

Work was also commenced in Bareilly. In addition to the above, test surveys were made of certain portions of the Náini Tál district.

318. The areas surveyed and the number of villages and fields of which the *khasras* were written up during the year ending 30th September 1897, together with the cost rates per square mile, are given in the following table :—

District.	Cadastral Survey, 16 Inch = 1 mile.		Record writing.			Average size of fields in acres.	Average cost per square mile.			
	No. of villages.	Area in square miles.	No. of villages.	No. of fields.	Area in square miles.		R	a.	p.	
Meerut	479	593	616	531,861	801	0·9	44	14	11	
Lálitpur Sub-division	224	501	224	129.353	501	2·4	53	14	3	
Bahraich	640	914	638	1,002,471	841	0·7	} 35	15	4	
Sítápur alluvial mahals	47	62	47	35,090	62	1·1				
Sháhjahánpur	1,184	806	1,184	624.257	806	0·8	40	15	7	
Kheri	654	755	654	500.842	755	0·9	42	8	4	
Bareilly	957	694	724	464,691	515	0·7	52	3	0	
	4,185	4,325	4,087	32,88,565	4,281		45	1	3	mean

* The officer in charge reports that Messrs. W. C. Price, G. W. Jarbo, J. S. Swiney and M. Gastaud have managed their sections in a satisfactory and able manner, and that the other assistants have also given satisfaction. Of the native establishment the following are deserving of special mention, Mr. C. Abrew, Azimulla Khan, Mahomed Umar Nasib Beg, Mahbub Alli, Tha Dun Gy[illegible] and Moung Hpo Kah.

319. A comparison of cost rates, with those of last year, shows that while in Bahraich, Sháhjahánpur and Kheri the expenditure per square mile has been reduced, that in Meerut and Lálitpur has increased, and in Bareilly it is high. In Meerut the total expenditure for the year has been less, but the area surveyed was comparatively small for the supervising staff, and a further expenditure was incurred by the employment of *amins* to survey difficult jungle covered *khadir* lands. In Lálitpur, owing to the famine, the *patwáris* were withdrawn from survey work during a considerable portion of the field season, and as the average size of the *patwáris* circles is nearly 8 square miles, and no *kánungos* were obtainable to aid in the work as in previous years, it became necessary to employ 50 *amins* which was done with the consent of the Board of Revenue. During the recess months also the *patwáris* were kept on famine work in their own circles, and paid *moharrirs* were engaged to prepare the necessary papers in office, otherwise the records of the sub-division could not have been completed this year.

320. In Bareilly the first two months of the field season were taken up entirely in training the *patwáris*, the course being much prolonged by their having to leave the classes several times for famine work, and they were again and again withdrawn, while regular survey was in progress often for a fortnight at a time or even more. In consequence, field work, especially *khasra* writing, had to be carried on till September, to allow of a sufficient area being completed for attestation. This entailed the maintenance of the supervising staff and a larger number of *mirdahas* throughout the recess months instead of up to May only, as is usually the case.

321. Except in Lálitpur, and the *khadir* lands of Meerut, where, with the consent of the Board, some *amins* were employed, the whole of the survey and record-writing was done by the *patwáris*, with, where necessary, the assistance of *kánungos* who had been sent for training; when the *patwáris* were aged and otherwise physically incapable, it was done by their recognized heirs or relatives. The general average outturn of a *patwári* per diem varied in the several districts from 10 to 18 acres of survey, and from 25 to 40 fields of record-writing. Some *patwáris*, during the latter months, surveyed an average of nearly 30 acres a day, while others never got beyond 9 or 10. Several earned rewards for large outturn, one man in Kheri earning R59 over and above his salary during the season. On the other hand, many had to be fined for laziness and absenting themselves without leave. On the whole, the improvement both in attendence and outturn was very marked.

322. Very few *kánungos* could be spared from their other duties, especially those in connection with famine, either for training or supervising. About 120 *umedwárs* received certificates after surveying one or more villages each.

323. In every square mile of survey from 2 to 3 linear miles were checked by chain lines run by inspectors and field-book or "independent" check lines of rather more than half a linear mile. In the *khasras*, from 10 to 20 per cent of entries were checked by inspectors. All European officers, with one exception, also tested the records in their respective districts, not as much as is desirable in all cases, but a single officer cannot be expected to do as much checking personally as is the rule in the Survey of India parties. The subordinate district officials had too much other work last year to allow of their assisting, but if in future they and the *kánungos* aid in checking the record-writing, the desired amount of check will be obtained. Several independent *partáls* were examined by the Superintendent himself in each district; as a rule the work was found to be very accurate. Some few sheets had to be entirely rejected and resurveyed, and in several cases sections of work in progress were rejected and resurveyed, but the proportion of rejected work to the entire area surveyed was very small.

324. The number of boundary disputes was much less than in previous years, and those not amicably settled on the ground were reported to district officers for disposal. They are chiefly in alluvial tracts, and those not disposed of before the rains set in, necessarily remained over till the coming field season.

325. Alluvial *mahals* were distinguished from permanent lands by a thick line and were separately numbered. Their former limits differ of course from the present high banks. To prevent confusion, the former limits of the *mahals* have been shown in thick lines, the present position of high banks being marked by the usual conventional sign of short hachures, thus the requirements of the settlement officers, and of the topographical draftsmen, are equally met.

326. Fluctuating cultivation is now distinguished from permanent in all districts by being inked in blue. Where possible, that is, in stony upland tracts, most of the minor quadrilateral stations are marked by crosses cut in stones *in situ* or embedded for the purpose, thus giving numerous accurate referring marks for resurveys whenever these became necessary.

327. The survey and record-writing of the Meerut district, and of the Lálitpur sub-division, have been completed, as also the mapping, tracing, area estimating and nearly all the papers required for attestation in Meerut, and for the Settlement Officer in Lálitpur. It is believed that all the records will be made over, complete, before the end of December in Meerut, and earlier in Lálitpur. In Bahraich an area of 440 square miles remains unsurveyed, and in Sháhjahánpur an area of 230 square miles. These should be completed during the coming season. The survey and record work of the Sítápur alluvial *mahals* have been completed. In Bahraich and Bareilly areas of 73 square miles and 181 square miles, respectively, have been surveyed in advance of the record-writing owing to the prolongation of the field season. Endeavours will be made to prevent this in future. In all other districts the records of all surveyed areas have been written up.

328. In office the mapping of surveyed areas is practically completed. Three sets of tracings (one showing soils) have been, or are being prepared. The calculation of field areas has been completed in most districts and is well advanced in others.

329. The old settlement village plans of districts Etah, Etáwah, Mainpuri and Azamgarh were examined and tested by the Superintendent and Mr. Johnson during the past season and reported on. It has been decided that all these districts are to be resurveyed before expiry of present settlement.

330. On a previous report submitted by the Superintendent on the present maps of the cultivated lands in the Náini Tál district, it was ordered that before a resurvey of any village was undertaken, the existing village maps should be carefully checked, and resurveys were only to be made where necessary. The survey of newly cultivated land and potato blocks was to be done. The sanction was only obtained in April 1897, and nearly a month elapsed before the establishment could be collected. It was evident that very little could be done before the rains set in. *Amins* from Garhwál were sent for, and meantime the Superintendent and Mr. Powell personally ran check lines across several villages. These showed such large discrepancies that it was decided to resurvey as many blocks as possible before the rains set in on the same scale as the settlement, *viz.*, 66 inches = 1 mile. To prevent needless expenditure, a small establishment of 2 inspectors and 20 *amins* only was engaged. Some were sent under Mr. Johnson to take up the survey of potato blocks in *pargana* Rámgarh, the remainder worked under Mr. Powell in *pargana* Chakhata. Work was closed in July when 76 blocks of ordinary cultivation containing 21,829 fields and 45 potato blocks had been completed. The average size of the fields was 20 to the acre which made the work extremely laborious and even the best surveyors could hardly do more than 2 or 3 acres a day.

331. A comparison with old maps showed these to be unreliable as a rule and on a further report to the Board, a complete resurvey was ordered. This will be commenced immediately and carried on as rapidly as allotted funds will permit. Simultaneously an index map on the 4-inch scale will also be compiled. The scale of ordinary cultivation will be that of 64 inches to the mile, of potato blocks 32 inches.

332. The cost of survey on such large scales on the hill sides will necessarily be great as compared with work on the plains, especially as it must be done by paid *amins*, there being no *patwáris* to do it. The work will be under the immediate charge of Mr. Powell.

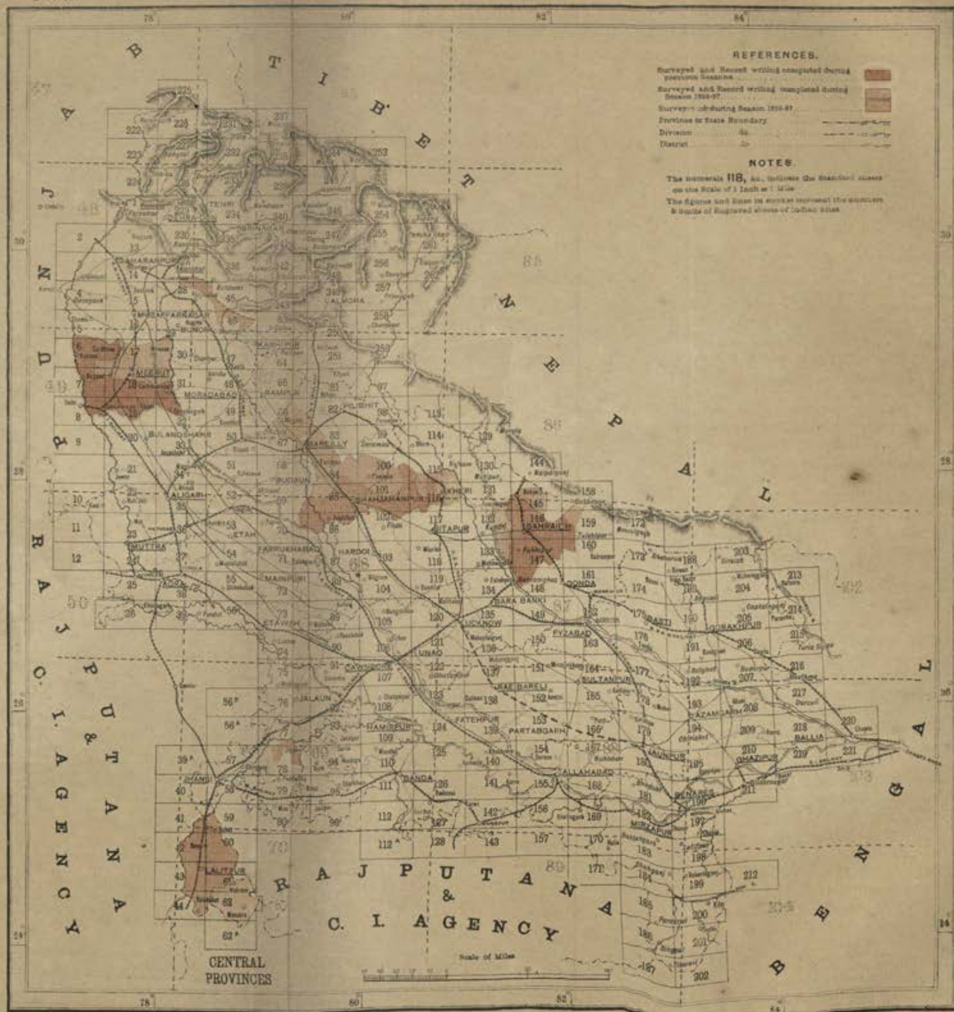
333. For the resurvey of the *halbandi* villages in Basti, mentioned in last year's report, Mr. Johnson started training classes for *patwáris* in Domariaganj, but the men were almost immediately withdrawn for famine work and the resurvey was postponed. It will be resumed during the coming season. Owing also to the famine, the proposed training of the Bánda *patwáris* was not begun.

In conclusion, the Superintendent would again call attention to the zeal, ability and hard work of the several officers in charge of the various operations.

N. W. P. & OUDH SURVEY.

INDEX TO THE LAND RECORDS SURVEY IN N. W. P. & OUDH.

1896-97.



Reg. No. 399, S. I. D.—Jan. 98.—500.

Photo. S. I. O., Calcutta.

No. 461-S. 97.

TRAVERSE SURVEYS.

NORTH-WESTERN PROVINCES AND OUDH.

No. 2 Party.

334. As during the previous year, No. 2 Party has been employed in traversing and supplying plots of the points thus fixed in certain districts of the North-Western Provinces. The party has remained throughout the year under the charge of Captain J. M. Fleming, I.S.C., with the exception of the period from 1st June to 23rd July, when Mr. W. S. Buttress held charge during Captain Fleming's absence on leave. Work was commenced at the beginning of November and terminated at the end of March, when a reduced establishment proceeded to recess quarters at Mussooree.

Personnel.

Captain J. M. Fleming, I.S.C., Officiating Superintendent, 2nd grade.
Mr. W. S. Buttress, Extra Assistant Superintendent, 1st grade.
H. Dowman, Extra Assistant Superintendent, 2nd grade, from 1st May to 20th September 1897.
" H. T. Hanby, Extra Assistant Superintendent, 2nd grade, from 12th October 1896 to 30th April 1897.
" C. G. Lee, Sub-Assistant Superintendent, 1st grade, from 26th October 1896.
" C. H. G. Johnson, Sub-Assistant Superintendent, 1st grade, from 1st to 31st October 1896.
" A. H. Peychers, Sub-Assistant Superintendent, 2nd grade.
Babu Jagadamba Prasad, Probationary Sub-Assistant Superintendent, 3rd grade, from 17th November 1896.
Mr. C. C. Byrne, Probationary Sub-Assistant Superintendent, 3rd grade, from 20th November 1896.
63 Sub-Surveyors, Computers, etc., etc.

335. During the field season two camps were maintained under the charge of Messrs. W. S. Buttress and H. T. Hanby respectively. Mr. Hanby proceeded on furlough from 1st May and was temporarily replaced in charge of a camp by Mr. Lee, who later made way for Mr. Dowman on his joining the party after privilege leave. Two sub-surveyors and five chain squads were retained in the field for a portion of the recess to undertake any required revisions.

336. The object of the season's work has been to furnish the settlement surveys with plots of the different villages traversed, showing the various traverse stations. The *patwáris* by whom the detail survey was carried out were thus supplied with a large number of fixed points on which to base their detail field-to-field survey.

337. The programme of work at first assigned to the party was quite insufficient to fully employ the establishment all through the year, and in addition to this, in order to finish rapidly certain *parganas*, the members of one camp had to be at first distributed in an uneconomical way, the result of which was that several men remained unemployed for a short period during the best working time of the field season. It was early pointed out that the allotted programme would not suffice, but only at the end of January was an enlarged sphere of work assigned to the party. The original area to be traversed comprised the completion of the Sháhjahánpur and Kheri districts, consisting of 237 and 1,679 square miles respectively, while the survey of the Bísalpur *pargana* of the Pilibhít district, an area of 370 square miles, was also ordered. Early in February, on receipt of orders, the traversing was extended further into Pilibhít, and the whole district, with the exception of the Jahánabad *pargana*, was easily completed by the beginning of April. In this latter tract work was much retarded by the fact that no demarcation had been done, but thanks to the energetic action of the Collector and his assistants this was pushed ahead, and everything was completed more rapidly than could have been expected. Had orders been received earlier, the whole Pilibhít district might have been finished with ease, and the cost rate thus much reduced.

338. Where reserved forest areas were met with, their external limits were traversed, here and there connecting lines being run through them along the cut fire lines to join the work on to village lands beyond. The total area traversed by the party, inclusive of 332 square miles of reserved forest area traversed round, amounts to 3,005 square miles. Plots of the area traversed in Sháhjahánpur and of the Srínagar *pargana* of the Kheri district were urgently required by the local survey officers, and these amounting to 445 villages on 622 sheets were all supplied by the end of February, plots of each batch of villages being forwarded immediately when ready. In addition to the current year's work one sub-surveyor with five chain squads had to be detained

for two months revising a portion of the previous season's work, and the completion of these computations occupied two computers considerably longer.

339. At the survey stations similar marks to those employed last season were erected, *i.e.*, stones were used for the triple junctions when unmarked by platforms, also at one satellite station of each triple junction and at two intermediate stations, when the distance between triple junctions exceeded half a mile, while in the vast majority of cases, locally made pottery cylinders were used to mark theodolite stations. These last would appear in no way to answer the requirements of a *permanent* mark. In the loose sandy soil found in the districts traversed, the cylinders are easily drawn out, and a visit to the area completed last season showed that a large percentage of these marks had already vanished, and it was a universal complaint of the *patwáris* who were met with at work, that the stations could only be identified by the distinguishing trenches dug round them, the marks themselves having been up-rooted. An attempt was made to utilize wedges of burnt clay of similar size and shape to the stones, but it was impossible to get these wedges burnt through in a satisfactory manner and their use had to be discontinued. The stones would seem to fulfil the requirements of a permanent mark in every way. Altogether in the season's operations 5,308 stones and 26,671 pottery cylinders have been embedded at the various traverse stations. The expenditure of marks was thus much less than that of last year and than was expected, due to most of the trijunctions having been found permanently marked by masonry platforms, and to a large number of forest and other pillars having been found and utilized. Estimating at considerably less than last year's requirements and to avoid the disappointments, experienced last season, the full estimated requirements were ordered during last recess. About 7,000 stones remained over, and these stored at different *tahsíls* will be utilized during the coming season's work. The stones were obtained from the same native contractor at Chunár at a cost of R145 per thousand, and including the charges for carriage, their average cost is about 4 annas 8 pie per stone. The pottery cylinders were all locally made, and were obtained at an average cost of about R3 per hundred. A large number of these were broken in transit over the rough country roads. These marks were distributed all over the districts under survey at convenient centres, and were thence obtained as required by the field hands.

340. The establishment was in every way superior to that of last year. The transfer of several good men from the Bihar Party and from No. 9 Party enabled the services of inferior men to be dispensed with. Much good resulted from insisting on every surveyor old and new completing a small village circuit under European supervision, which had to be computed and proved before he was allowed to proceed to work.

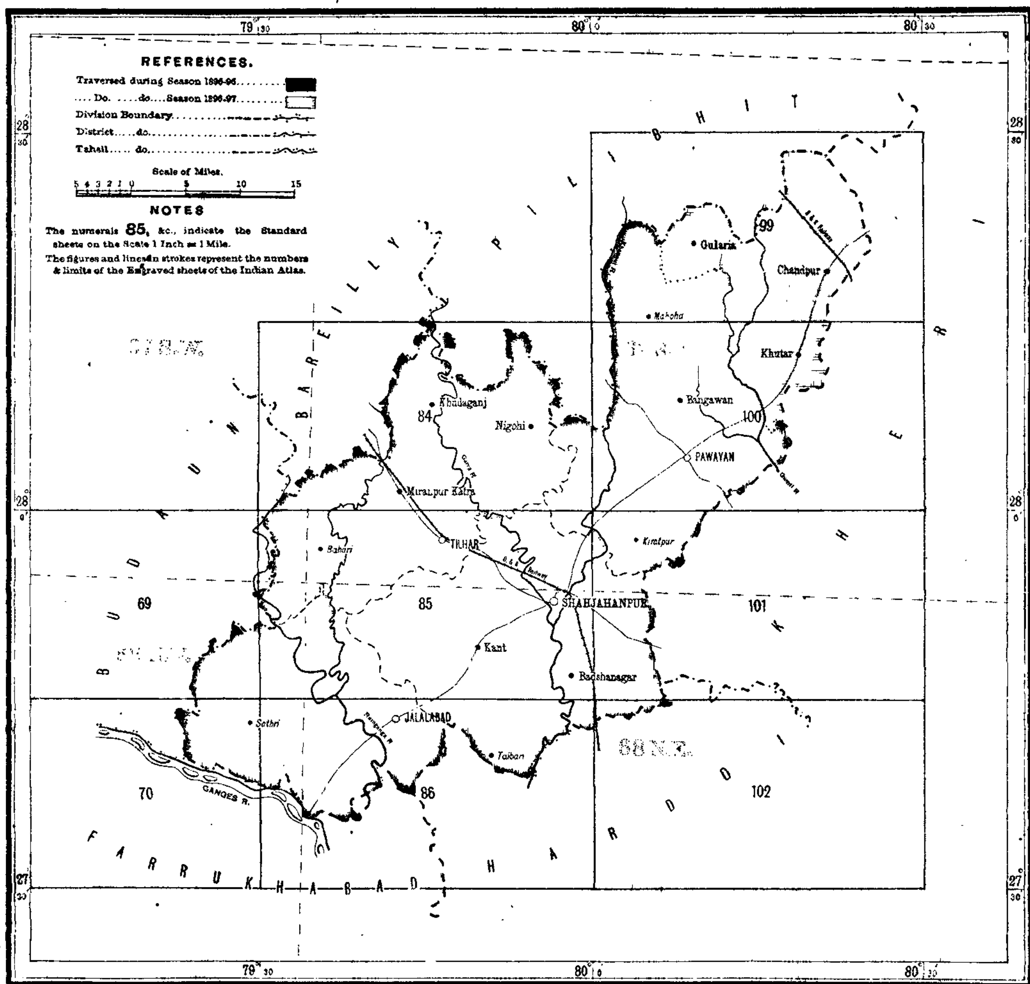
341. The demarcation in Sháhjahánpur was most imperfect resulting in much delay and incorrect survey, there being no one to point out boundaries in the jungle tracts and hence revisions had to be made in many cases. In Kheri this season the demarcation was most excellent and thanks are due to the Deputy Commissioner for the assistance always given when asked. In Pilibhít too the Collector and his assistants did every thing in their power to assist the party, and the demarcation in the Bísalpur *pargana* was excellent. In the other two *parganas* owing to lack of notice, the demarcation was imperfect, but was pushed on as fast as possible. In the Tarái portion, however, none existed, nor would the absentee proprietors aid until late, in spite of the Tahsildár's efforts to make them.

342. The line clearing squads kept well ahead in Sháhjahánpur and in the Bísalpur *pargana* of Pilibhít, having started a clear month in advance. In the remainder of Pilibhít owing to the late receipt of orders, the men never got ahead of the surveyors even when strengthened by additional squads from the Kheri camp, and in many cases the surveyor's squads had to be taken from their work and sent to assist them. The same thing happened in the last *pargana* traversed in Kheri, but the heavy jungle met with caused the retardation of the work. Generally speaking the villagers rendered ample assistance.

343. Two chains of 100 links and 93 links respectively were employed on main and sub-circuits, the results of both measurements being at once compared. A single chain of 100 links was used on the village circuits. The origin of the

N. W. P. & OUDH SURVEY.

1896-97. **INDEX TO THE TRAVERSE SURVEY IN DISTRICT SHAHJAHANPUR.** No. 2 PARTY.



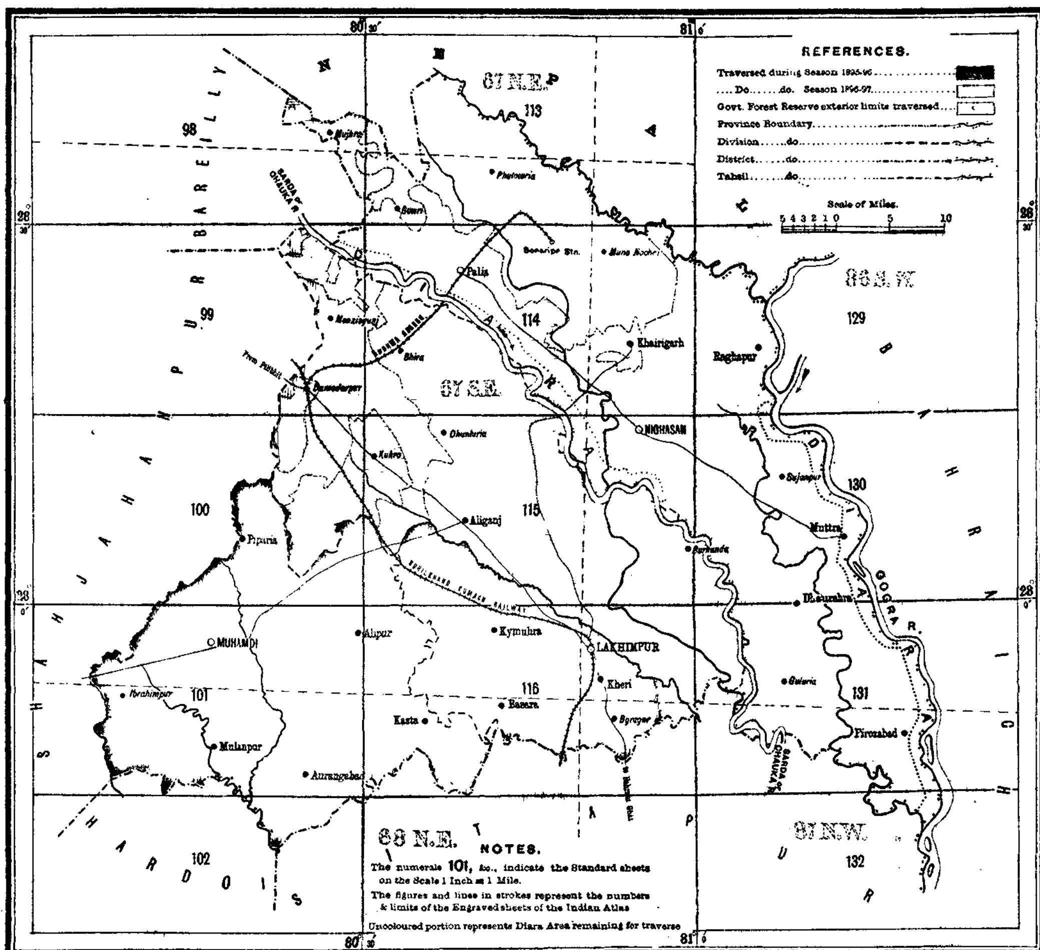
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Photo. S. I. O., Calcutta

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N. W. P. & OUDH SURVEY.

1896-97. INDEX TO THE TRAVERSE SURVEY IN DISTRICT KHERI. No. 2 PARTY.

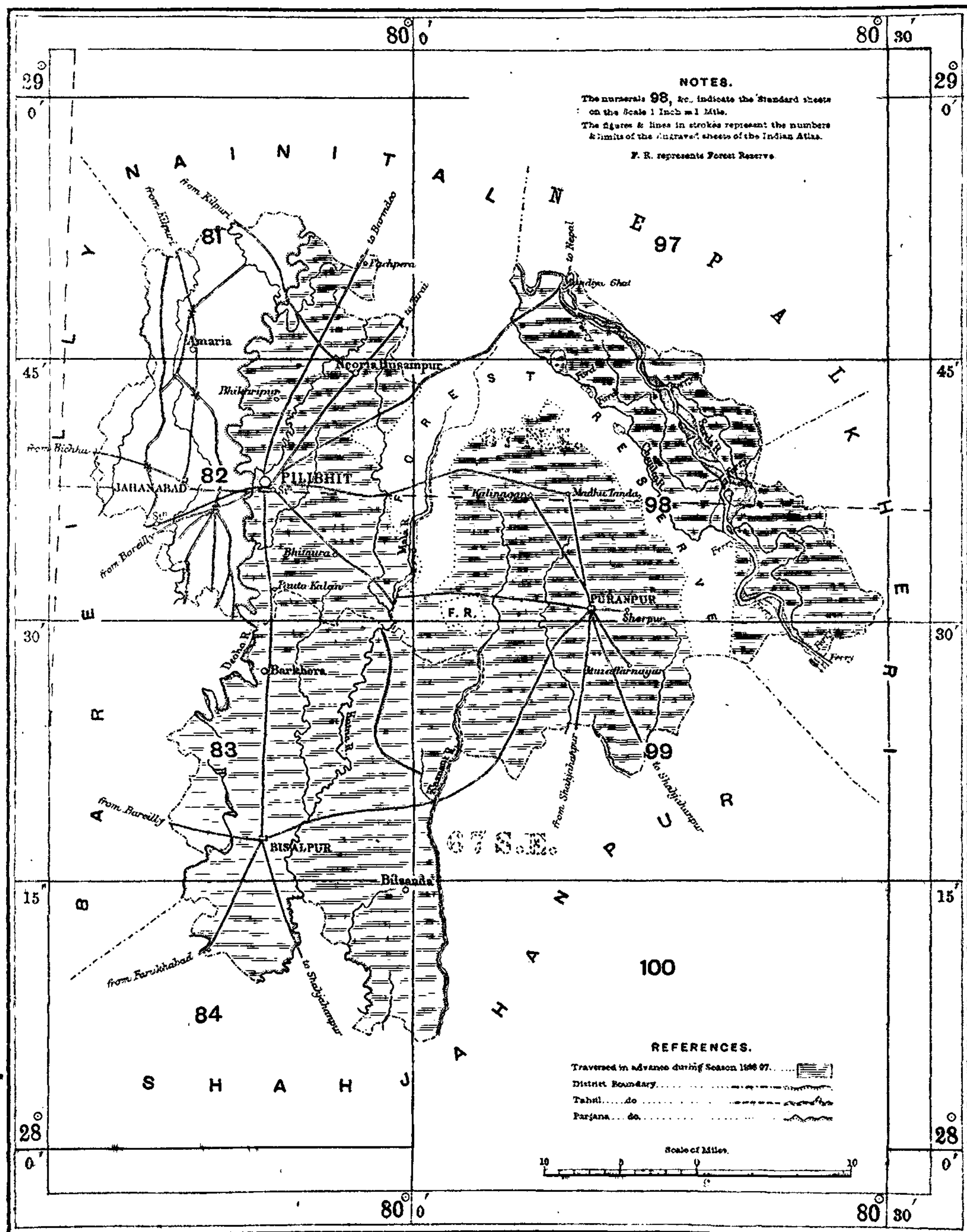


E., No 328 S. I. D.- Feb. 98.-65. Photo. S. I. O., Calcutta.

No. 312-S. 98

N. W. P. & OUDH SURVEY.

1896-97. INDEX TO THE TRAVERSE SURVEY IN DISTRICT PILIBHIT. No. 2 PARTY.



Reg. No. ... S. I. O.—Feb. 98.—600.

Photo. S. I. O.,

No. 314-S. 98.

survey of all three districts remained as last year, *viz.*, the intersection of the parallel of 28° North Latitude with the meridian of 80° East Longitude. To this the rectangular values of all stations on the main and sub-circuits have been referred. Observations for azimuth were taken at 255 stations to correct the angular work at about 30 stations apart, and, at nearly all these, observations to ascertain the magnetic variation were made To confine the chain errors connections were made tc 18 stations of the G. T. Survey and the values deduced from these were invariably adopted. Whenever possible the traverse work and stations of other parties in adjoining districts were utilized.

344. The following table gives particulars of the out-turn in each district:—

DISTRICT.	Number of villages.	Number of sub-traverses.	Number of angles observed.	Linear miles chained.	Village area in square miles.
1	2	3	4	5	6
Sháhjahánpur	297	250	5,165	813	237·48
Kheri	751	1,015	21,503	4,140	(a) 1,599·77
Pilibhít	1,074	917	18,834	3,282	(b) 1,167·90
TOTAL .	2,122	2,182	45,502	8,235	3,500·15

(a) Includes 181·3 square miles of Reserved Forest surveyed round in block.
(b) „ 150·7 „ „ „ „ „ „ „

345. The average area of the village in Sháhjahánpur was 0·80 of a square mile, in Kheri 1·89 square miles, the *mauzas* in the last *parganas* surveyed being very large, and in Pilibhít the village area works out to about 0·95 square mile per village.

346. Several of the tracts surveyed are in an ordinary year very malarious and unhealthy, but owing to the scanty rainfall of the previous summer the ground had all dried up, which apparently kept off the usual malaria. There was little sickness of any kind and only two deaths were reported.

347. The computations have all been completed and bound in suitable sized volumes. Besides the computations, plots of 2,120 villages on 3,546 sheets on the 16-inch scale have been prepared and forwarded to the local survey officers. Along with these 173 sheets of congregated village plots on the 4-inch scale, showing the number of the stations and the marks embedded at each, have also been prepared and forwarded. Charts of each district on the ¼-inch scale, showing azimuth and triple junction stations on the main and sub-circuits, have been made out as a guide to the 2-inch mapping to be shortly commenced.

348. The total expenditure of the party has been R81,624. This divided among the three districts gives the expenditure incurred on account of work in each district as under:—

	R
Sháhjahánpur	6,437
Kheri	43,461
Pilibhít	31,726

The resulting cost rates for the whole party work out to R3-7-1 per square mile for stone embedding, etc., and R23-11-6 for traversing, or for the combined operations R27-2-7 per square mile. These figures include heavy transfer charges. Could a sufficient programme have been at first laid down, and thus allowed of better arrangements being made to keep the men fully employed, much more work might have been done for the same money and the rates would have been considerably less. There also remains a large stock of stones in hand, and deducting the actual cost of these, excluding rail charges (R1,015), the cost rates would only be R3-1-8 for stone embedding and R23-11 6 for traversing, or R26-13-2 per square mile for the combined operations.

349. The Officiating Deputy Surveyor-General inspected the party in recess during September.*

No. 8 Party.

350. This party was in charge throughout the season of Mr. J. S. Pemberton. The recess office was closed at Náini Tál on the 12th October and field work was started in districts Meerut, Bareilly, Bijnor and Gonda between 1st and 7th November. Recess office was reopened at Náini Tál on the 12th April. The changes in the establishment were as follows: the transfer of Mr. R. B. Smart from No. 4 Party to take the place of Mr. W. J. O'Sullivan, who died on the 12th October 1896, and of Mr. J. Murphy and Munshi Aulad Hossein from Nos. 7 and 22 Parties respectively. Mr. P. L. Causley, though borne on the list of the party from the commencement of the season to 2nd April 1897 when he was transferred to the Head-Quarters office, Calcutta, was, during the entire period, on sick leave.

Personnel.

Mr. J. S. Pemberton, Deputy Superintendent, 2nd grade, in charge.
„ W. J. O'Sullivan, Extra Assistant Superintendent, 3rd grade up to 12th October 1896.
„ R. B. Smart, Extra Assistant Superintendent, 3rd grade, from 20th October 1896.
„ J. Murphy, Extra Assistant Superintendent, 5th grade.
„ G. Rae, Sub-Assistant Superintendent, 2nd grade.
„ J. H. Murphy, Sub-Assistant Superintendent, 2nd grade, from 16th September 1897.
Aulad Hossein, Sub-Assistant Superintendent, 2nd grade, from 28th November 1896.
Mr. P. Williams, Sub-Assistant Superintendent, 2nd grade.
„ P. L. Causley, Sub-Assistant Superintendent, 3rd grade, to 2nd April 1897.
70 Sub-surveyors and others.

351. The programme for the season was as follows:—

(*a*) *District Meerut*.—The alluvial lands along the Ganges river in *parganas* Hastinapur and Kithor and the river itself, comprising 175 square miles.

(*b*) The remaining area of district Bareilly, 744 square miles, comprised in *parganas* Bareilly, Nawábganj, Sarauli south, Aonla, Sancha and Ballia and the alluvial lands in *parganas* Sarauli North, Bareilly and Farídpur.

(*c*) *District Gonda*.—1,000 square miles in *parganas* Nawábganj, Mahádewa, Gonda, Pahárapur and Digsar.

(*d*) *District Bijnor*.—400 square miles in *parganas* Chándpur, Báshta, Burhpur and Nagína.

The total area for the season was thus a little over 2,300 square miles, somewhat less than the establishment was capable of performing under ordinary circumstances, but which it was thought inadvisable to reduce, in view of anticipated difficulties due to scarcity in the country and other reasons; the cost rates were necessarily increased by the limited area. The party was divided into two sections, which were in charge of Messrs. J. S. Pemberton and R. B. Smart.

District Meerut.

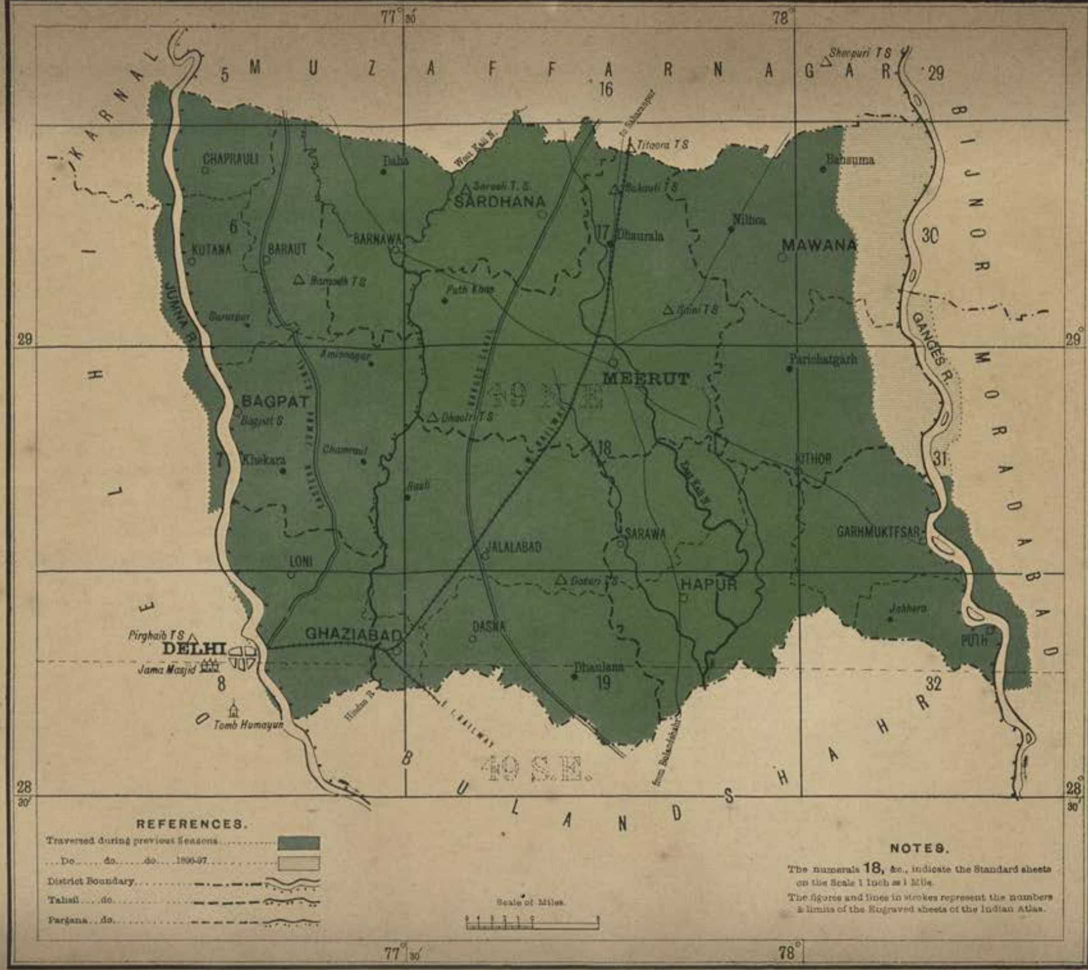
352. The area for survey in this district originally formed part of the programme for 1895-96, but had been postponed owing to the Land Records Department not being prepared to take up the cadastral survey during that season. To ensure this being completed before the next rains set in, traverse work was started about the 1st November 1896 and completed on the 28th January following. All the 16-inch skeleton plots of the area comprising 94 villages were made over to the survey officer in instalments, as quickly as they could be got ready, the last having been delivered early in March.

353. The country for the most part was covered with dense reed and grass jungle which necessitated the employment of special labour for clearing; this coupled with the almost complete absence of demarcation, interfered very much with satisfactory progress, and was a great source of trouble and delay. The ready assistance rendered by Mr. Freeman, the survey officer of the district, in allowing his *patwáris* to assist, helped most materially in completing the traverse survey in good time.

* Captain Fleming reports favourably of the work done by Messrs. Hanby and Dowman, and says that both Mr. Byrne and Jagadamba Prasad promise well. In the native establishment sub-surveyors Wali Mahomed, Ram Sarup, Inyatullah, Ahmed Husain, Basant Rai, Isswer Singh, Gokul Chand, Ghaus Mahomed and Wahid Ali, computers Manohur Lal, Mahadeo Ram, Annada Prasad Ghosh, Dharam Nath and Sheik Gazi, and writer Jagneshwer Bhuttacharjee have all been reported as having done well.

N. W. P. & OUDH SURVEY.

1896-97. INDEX TO THE TRAVERSE SURVEY IN DISTRICT MEERUT. No. 8 PARTY.



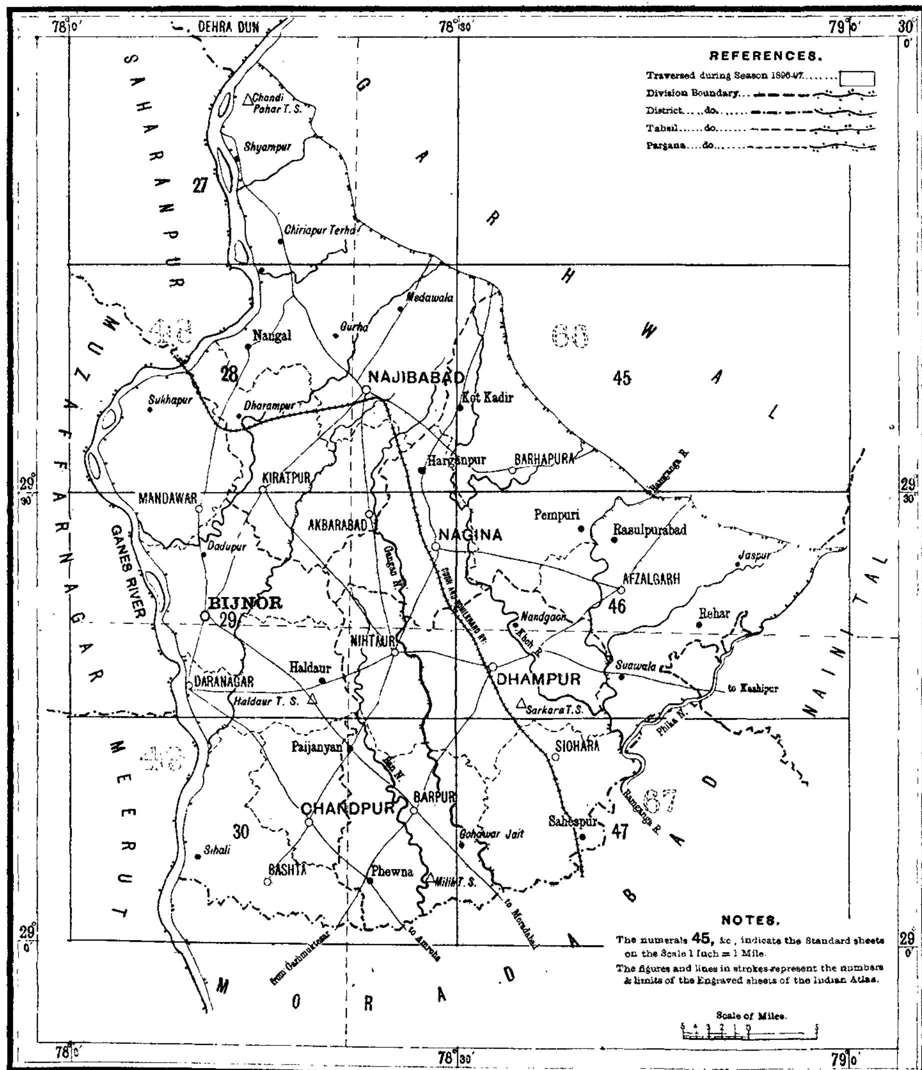
Reg. No. 330, S. I. D.—Dec. 97—530 Photo S. I. O., Calcutta.

No. 476-S. 97.

N. W. P. & OUDH SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT BIJNOR.

1896-97. No. 8 PARTY.



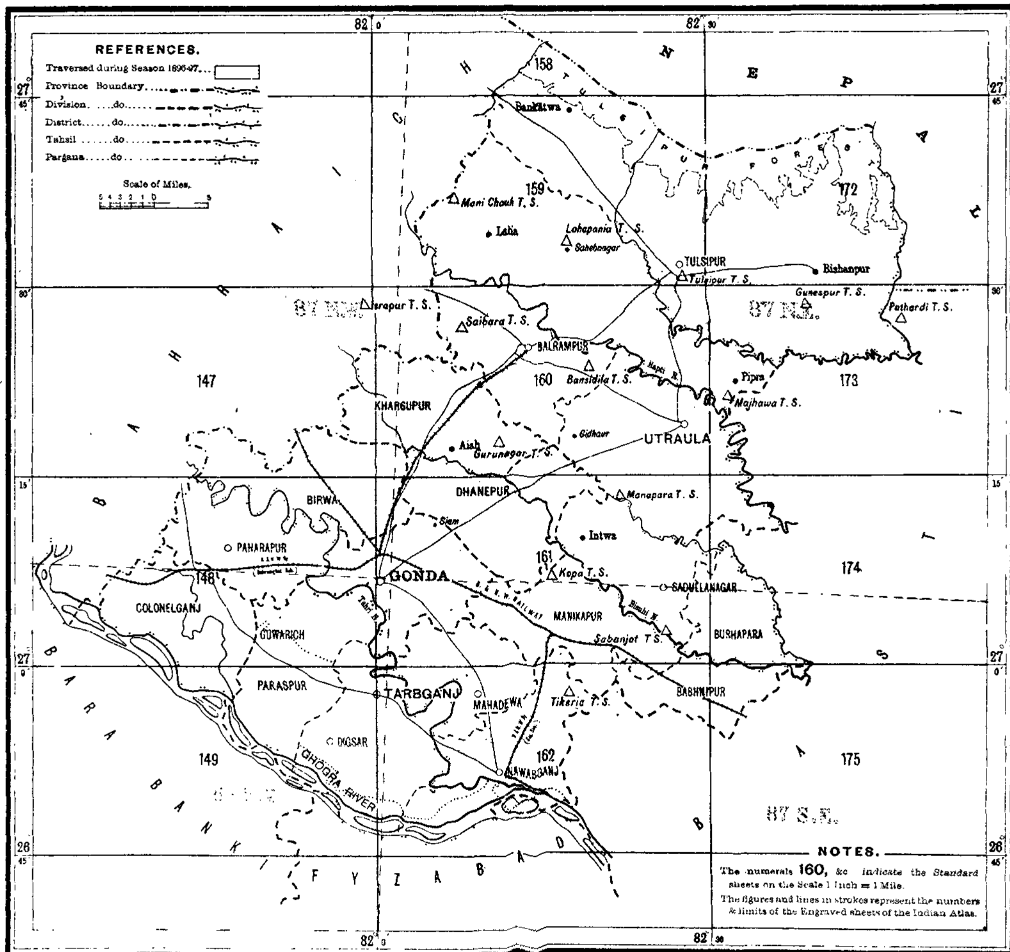
Reg. No. 261, S. I. D.—Dec. 97—550. Photo. S. I. O., Calcutta.

No. 475-S. 97.

N. W. P. & OUDH SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT GONDA.

1896-97. No. 8 PARTY.



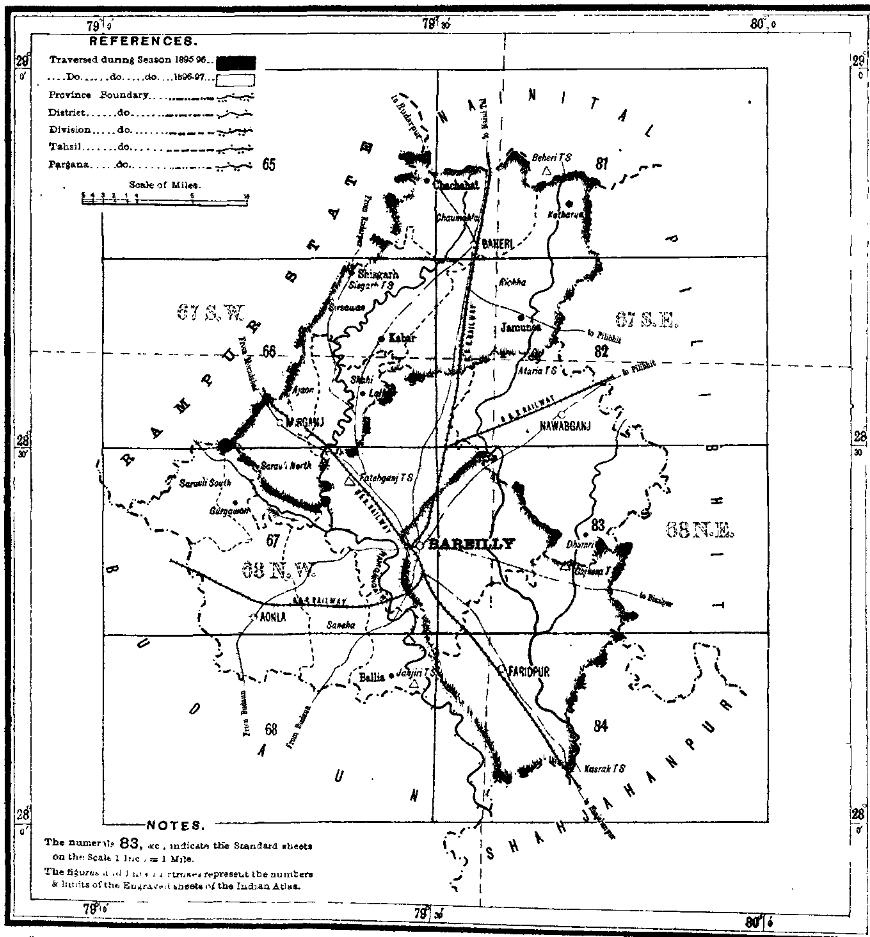
Reg. No. 267, S. I. D.– Dec. 97.–550 Photo. S. I. O., Calcutta.

No. 474-S. 97.

N. W. P. & OUDH SURVEY.

INDEX TO THE TRAVERSE SURVEY IN DISTRICT BAREILLY.

1896-97. No. 8 PARTY.



Reg. No. 328, S. I. D.—Dec. 97—550.

Photo. S. I. O., Calcutta.

No. 473-S. 97.

DISTRICT BAREILLY.

354. It was in the civil station of this district that the head-quarters camp of the party was established; here all hands met for final orders and instructions, excepting only the native establishment of the camp in charge of Mr. Smart, which was ordered to assemble at Bahraich on the 1st November. The sudden death of Mr. O'Sullivan at the close of the recess season, when arrangements for taking the field were in progress, threatened some delay, but Mr. Smart very promptly took over the management of his camp and was at his post in good time.

The unsatisfactory state of demarcation and the want of assistance from *patwáris* and villagers tended to delay the work in this district.

Though there was no actual famine, there was much scarcity, as was evinced by high prices and the general condition of the very poor.

355. The first cadastral survey operations in this district by the Land Records Department, were started this season, in *parganas* Mírganj, Farídpur and Bareilly which were traversed last year. The 4-inch and 16-inch skeleton plots of this area were delivered to Mr. L. F. Berkeley the survey officer early in November.

The field work of the whole district having been completed, the camp broke up on the 10th February and moved to Bijnor.

DISTRICT GONDA.

356. Field work was started on the 7th November and brought to a close on the 26th March. The programme was slightly modified; 50 square miles of alluvial lands along the Gogra river being relinquished in *parganas* Nawábganj and Digsar, to meet the requirements of the cadastral survey, which was not to be started till the following season, and an equal area taken up in *pargana* Guwárich. The general condition of the country as regards famine, was much the same as in Bareilly, the principal difficulties being the want of assistance from *patwáris* and villagers and the unsatisfactory demarcation.

DISTRICT BIJNOR.

357. Field work was started on the 1st February and completed on the 4th April, which was the closing day of the field season for the party.

In this district 339 square miles had been traversed by the Land Records Department in 1894-95 in *parganas* Barhapura, Najíbábád and Afzalgarh under the supervision of Mr. T. F. Freeman, Deputy Collector and Survey Officer of district Meerut. This survey was carried out when it was thought no professional aid would be required in the district and that the existing *patwári* maps would answer all purposes for a new settlement. This idea was acted on, till the entire district, excepting only *parganas* Chándpur, Báshta, Burhpur and Nagína, was completed, *i.e.*, *patwári* maps were brought up to date and used for settlement purposes. Then the Board of Revenue decided to do the cadastral survey of the remaining *parganas* according to the new system, and the services of this party were called in to do the preliminary traverse.

358. The demarcation throughout the entire area traversed during the past season was decidedly defective; in parts it was imperfect and in others it was entirely wanting. The reason of this appeared to be, that orders were not issued sufficiently early by the district authorities, so as to give villagers time for erecting the required marks which, according to present orders, are mud pillars from two to three feet high plastered over. To obviate this difficulty in the future, it is suggested, in lieu of mud pillars to have only temporary marks erected immediately in advance of the traverse survey, such as bamboos or posts of sufficient height to catch the eye of the surveyor. A more permanent demarcation could subsequently be carried out to meet the requirements of the cadastral survey. The subject is of sufficient importance to call for early attention, as the want of demarcation not only causes the loss of valuable time to the surveyor, but entails a constant risk of running traverse lines farther from the boundary than is prescribed by the rules or even of omitting a boundary altogether. In connection with the subject, it may be mentioned for future reference, that the mark stones collected by the Settlement Department at several centres in districts Bareilly and Bijnor for erection at trijunction points of villages, were not embedded at the time of the traverse survey now reported on.

359. It is as well also to mention that the list of village names obtained from the Collectors' offices are invariably incomplete and often inaccurate.

The particulars of the season's outturn are given in the following table :—

Districts.	Number of Villages and River Blocks.	Number of Sub-traverses.	Number of Traverse Stations.	Linear miles of Traverse.	Area in square miles.	
Meerut	94	75	1,431	315	115·25	2 Main Circuits.
Do. River Blocks	7	...	244	60	59·91	
Bareilly	972	937	11,776	2,750	744·35	9 Main Circuits (including 5 supplementary circuits).
Bijnor	778	457	7,326	1,684	403·10	3 Main Circuits.
Gonda	1,167	1,020	16,452	3,752	1,003·63	5 Ditto.
TOTALS	Villages 3,011 River Blocks 7	2,489	37,229	8,561	2,326 24	

360. The total expenditure for the survey year ending September 30th 1897 amounts to R67,479, and the average resulting cost rate per square mile to R29-0-3. This is in excess of both the preceding seasons, and is due to the following causes (1) extra expenditure in moving both camps from one district to another, (2) employment of extra labour in jungle-clearing in district Meerut; and (3) to the smaller area completed.

361. The following permanent marks for traverse stations were used during the season :—Stones 7,146, cylinders 23,293, baked clay marks used as substitutes for stones 606. Stones, or the substitutes above referred to, were embedded, first at trijunctions of villages where no marks were found to exist, secondly at one of three satellite stations at every trijunction, and lastly at two intermediate consecutive stations between trijunctions which were a mile or more apart. All other stations were marked by clay cylinders locally made.

The cost of each description of mark purchased during the season was as follows:—Stones, R1,998-0-0 (including railway freight), substitutes for stones R101-4-6; and cylinders R266-4-6, making a total cost of R2,365-9-0. The marks left unused and available for next season are :—Stones 1,380 and cylinders 3,800. The cost of local carriage for all descriptions of marks amounts to R2,440-11-3, being R2-1-1 per square mile; in addition to the above mile and furlong stones, masonry pillars, monoliths, etc., were taken advantage of as traverse stations. A description of every station has been noted by symbols in the traverse tables and field books.

362. The area was as usual divided into main and sub-circuits, the former invariably following *pargana* boundaries, except where alluvial lands intervened, when they were run along the high banks forming the limits of such lands. The *mauza* was the unit in the system of survey adopted, each *mauza* being sub-divided by traverses at an average distance of forty chains apart, which provided a sufficient number of stations for the cadastral surveyor. Distances on main, sub and village circuits were measured with 2 chains of 100 links and 93 links respectively in all but district Gonda, where a single chain of 100 links was used for sub and village circuits. Azimuth observations were taken on main and sub-circuits at 236 points in the season's work.

A total number of eleven Great Trigonometrical Survey stations were incorporated with the season's work; the results of comparison of direct distances as obtained from Great Trigonometrical survey data, and the traverses are good in all but four cases, all in district Gonda. The towers of all stations were found in a good state of preservation in all but one instance, *viz.*, Kopa Trigonometrical Station which had fallen in parts and was repaired.

The following skeleton plots on 4-inch and 16-inch scales were prepared during the season :—3,011 villages on 104 sheets on the scale of 4-inches=1 mile; and 3,011 villages in 3,899 sheets on the 16-inch scale. In addition to the above, the plots of 414 villages on the 16-inch scale in district Basti and 104 villages on the 32-inch scale in district Bahraich, were prepared for the Land Records Department. Traverse charts on the scale of 4 miles=1-inch have also been prepared of each of the districts, as indexes to the traverse tables.

363. Field inspection of parties while actually at work, was particularly attended to, and the executive officer also inspected the office of the camp at

No. 6 PARTY.

ASSAM SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTS. KAMRUP, DARRANG, NOWGONG, & SIBSAGAR, &c.

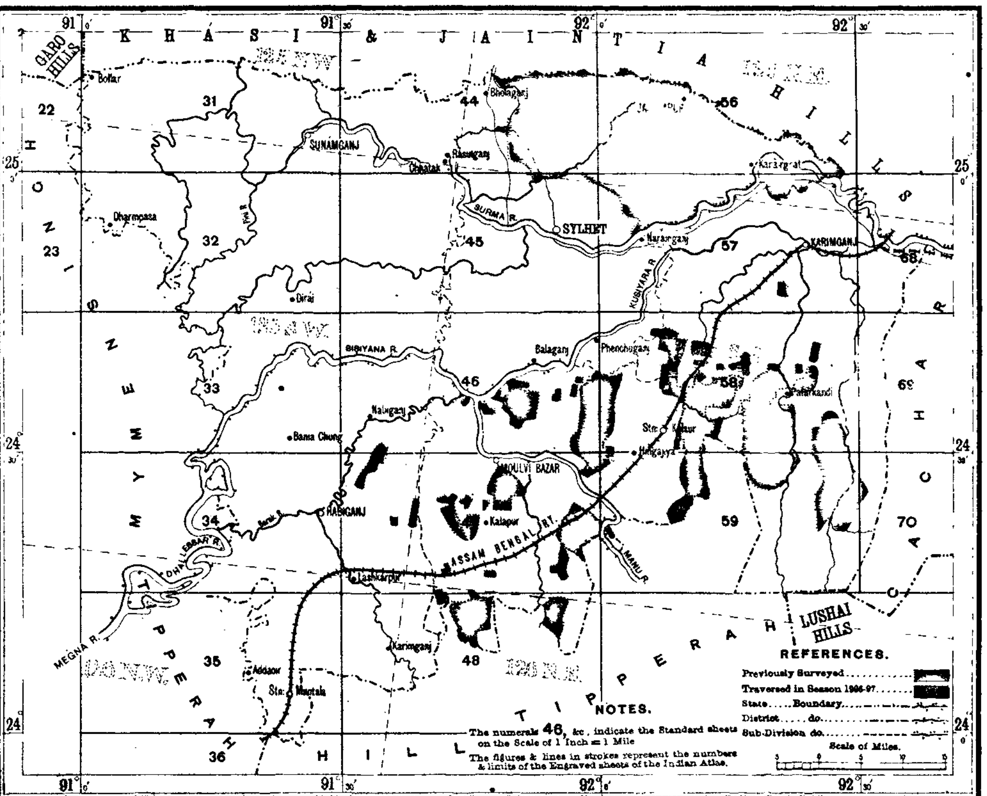
1896-97.



ASSAM SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DIST. SYLHET.

1896-97. No. 6 PARTY.



Reg. No. 431, S. I. D.—Mar. 98.—550.

Photo., S. I. O., Calcutta

No. 337-S. 98.

Gonda. The office of the party was inspected during the recess by Lieutenant-Colonel J. R. Hobday, Officiating Deputy Surveyor-General.*

ASSAM.

No. 6 Party.

Personnel.

Mr. E. C. Barrett, Superintendent, 1st grade, in charge to 1st May 1897.
Captain C. W. H. Symonds, Officiating Deputy Superintendent, 2nd grade, in charge from 25th August 1897.
Mr. W. H. Penrose, Extra Assistant Superintendent, 5th grade, in charge from 2nd May to 24th August 1897.
Mr. F. S. Bell, Sub-Assistant Superintendent, 1st grade.
20 Permanent and 71 temporary Sub-Surveyors, Computors, etc.

364. Mr. Barrett held charge of the party until the 1st of May 1897, when he was compelled by sickness to take six months furlough, and Mr. Penrose assumed temporary charge of the party until he was relieved by Captain C. W. H. Symonds on August 25th, 1897. The head-quarters camp under Mr. Barrett left Shillong on the 16th October, and arrived at Dhubri on the 21st idem. A detachment which worked the whole season under Mr. Penrose in Sylhet left Shillong on the 5th October and commenced work at Maulvi Bázár on October 15th.

365. The programme of the party comprised the traverse of about 1,500 square miles lying in the Assam Valley and the Sylhet district, and the traverse and topographical survey on the 2-inch scale of 600 square miles situated in the Assam Valley; also the revision of about 540 square miles of cadastral survey in Cachar.

366. In the tables below will be found the outturn of the party in both the Assam Valley and the Sylhet district:—

Assam Valley.

Districts.	Cadastral area surveyed by local agency.		Cadastral area to be surveyed by local agency.		Topographical survey on 2″=1 mile.	Area in square miles.
	No. of villages.	Area in sq. miles.	No. of villages.	Area in sq. miles.	Area in sq. miles.	Grand Total.
Goálpára	(a) 183	203·9	(c) 55	83·5	5·9	293·3
Kámrúp	(b) 260	263·0	(d) 26	45·9	623·3	932·2
Total	443	466·9	81	129·4	629·2	1,225·5

(a) Bijni Duárs.
(b) Sidly Duárs, Circles 1, 2, 4 and 5.
(c) In *Parganas* Rupusi, Chokabandi, Dumká, Duár Bijni, Chapa Khamar.
(d) Bhowánipur, Hastinápur, Karijalbaden, Paka, Chapaguli.

Surmá Valley.

District.	Ordinary *ilam* lands.	Modified *ilam* lands.	Waste land grants.	Applied for grants.	Jungle-buri grants.	Permanently settled lands.	Total.
	Square miles.	Square miles.	Square miles.	Square miles.	Square miles.	Square miles.	Square miles.
Sylhet	103·3	30·4	53·0	7·9	2·0	11·1	207·7

* The officer in charge reports that Mr. R. B. Smart, the senior assistant, has conducted his duties in a most satisfactory and able manner, and that Messrs. J. Murphy and G. Rae have rendered efficient service. In the native establishment Computors Latifulla Khan and Kanhaia Lal and Sub-surveyors Elahi Buksh, Hayat Mohammad, Mumtaz Ali and Ramphal as well as the English writer Sanat Kumar Chatterjee are commended.

The area traversed in Assam for local agency and for 2-inch detail survey lay in a more or less compact block in Goálpára and Kámrúp. The country to a great extent was devoid of jungle with the exception of those portions which lay along the banks of the Brahmaputra river. Here the traverse work was greatly retarded owing to its being necessary to cut lines through dense *ekra* jungle. In the Sylhet district the various description of *ilam* lands and grants were situated in the hilly and jungly country to the south-west of the district, and great difficulty was experienced in the line-cutting, especially in surveying the boundaries of grant lands.

367. A survey class was opened on January 2nd, 1897, at Maulvi Bázár, under the superintendence of Mr. Penrose, for the purpose of instructing the following officers in field-to-field surveying :—

Lieutenant Playfair, Mr. S. S. Skinner, Mr. J. F. Jackson, one Extra Assistant Commissioner, two Sub-Deputy Collectors and one selected candidate. Of these Lieutenant Playfair and one Extra Assistant Commissioner passed. The remaining five after a course of one month were exempted from further training by the Chief Commissioner.

368. In the Assam Valley the intersection of latitude 26° 30′ and longtitude 90° 30′ was assumed as the origin of survey. In Sylhet the origin of the old Jaintiá survey was preserved, namely, the intersection of latitude 24° 30′ and longtitude 90° 00′. The theodolite was set up at 22,591 stations and the aggregate length of the traverse lines amounted to 3,278 linear miles. The angular work was checked by 240 azimuths.

369. In those villages in the Assam Valley which had already been surveyed cadastrally by local agency and were traversed this season, all old marks were utilized as theodolite stations. In the villages which will be surveyed by local agency all theodolite stations were marked by a stout wooden peg, and in order to facilitate the identification of these marks, a *semal* bough was planted 5 feet magnetic north. These stations will be permanently marked by the Settlement Department. In the area traversed for 2-inch detail survey all stations were marked by pegs with the exception of old stations, which were utilized wherever they could be found. In the Sylhet district in the survey of *ilam* lands and tea grants, all new theodolite stations were similarly marked. Of these 369 in number were identified and utilized as theodolite stations. In all grant lands in Sylhet every endeavour was made to adhere to the old boundaries according to previous surveys. In the survey of *ilam* lands the boundaries were surveyed as pointed out by the Settlement Officer.

370. The revision survey of 540·5 square miles of cadastral survey completed in 1894-95 was continued during the season under report, with an establishment of 32 *amins* assisted by a settlement *munserim* ; these *amins* were gradually discharged, and at the end of the season only two remained, one being employed in the Silchár town and the other in a few of the different tea grants.

371. The area surveyed topographically on the 2-inch scale in the Assam Valley has been mapped on 19 field sections.

372. The Settlement Officer has been supplied with 295 sheets plotted on 16-inch scale and also with 2-inch plots of the same sheets.

373. The following have been supplied to the Director, Land Records, Assam :—

(*a*) 571 plots of villages in the Kámrúp and Goálpára districts on the 2-inch scale.

(*b*) 176 sheets of Goálpára and Kámrúp districts plotted on 16-inch scale.

374. In the Assam Valley the attitude of the people was all that could be desired, but in the Sylhet district considerable obstruction was experienced from the native permanent settlement holders holding *ilam* and other lands.

375. The programme for the season 1897-98 consists of the following :—

Assam Valley.

(1) Topograhical survey of the Brahmaputra riverain, extending in continuation of the season's work up to Longitude 93° east, and of gaps left between previous cadastral svrveys covering about 1,430 square miles.

(2) The traverse survey of 240 square miles over which local surveys have been extended between Longitude 91° and Longitude 93°.

(3) Traverse survey of certain tea grants, some already taken up, others applied for only, occupying about 90 square miles.

Sylhet District.

(1) Traverse of *ilam* lands, tea grants, etc., covering an approximate area of 200 square miles.

376. On June, the 12th, Shillong was visited by an earthquake which completely wrecked the office bungalow and all the records, furniture and instruments were covered by a mass of stones and debris. To add to the difficulties experienced by the officer in charge in rescuing all the above records, instruments, etc., the earthquake was followed by a continuous downpour of rain which lasted for 48 hours. Comparatively very few of the records and instruments were damaged, and great credit is due to Mr. Penrose and the native establishment for the energetic way in which the searching for, and rescuing of, Government property was carried out. Mr. Penrose expresses his cordial thanks for the very valuable assistance rendered him, by the Officer Commanding the 42nd Gúrkha Rifles and the Officers of the Public Works Department.

The following maps and records have been either lost or destroyed.

1. Six 2-inch standard sheets received from Calcutta.
2. One hundred of the original 16-inch sheets of Cachar.
3. The entire correspondence and a few corrections referring to the Sylhet and Cachar cadastral work.

Of these Nos. 1 and 2 will have to be re-drawn.

377. The party was inspected by Lieutenant-Colonel Hobday, Officiating Deputy Surveyor-General, during the recess at Shillong, prior to the earthquake, when the records and mapping were thoroughly examined, and proposals submitted for the retention of the party in Assam, to complete the standard mapping.*

GEODETIC.

LATITUDE OF MADRAS.

Nos. 22 and 23 Parties, Astronomical.

378. As Captain Burrard, the officer in charge of these combined parties, was under orders to take over charge of the Tidal Party in December 1896, advantage was taken of the short season thus available to investigate a discrepancy in the latitude of the Madras observatory which had come to light.

Personnel.

Captain S. G. Burrard, R.E., Deputy Superintendent, 1st grade, in charge up to 31st January 1897.
Mr. J. Eccles, M.A., Deputy Superintendent, 1st grade, in charge from 1st February to 15th March 1897.
Captain G. P. Lenox-Conyngham, R.E., Deputy Superintendent, 1st grade, in charge from 16th March 1897.
Munshi Aulad Hussein, Sub-Assistant Superintendent, 2nd grade, up to 20th November 1896.
Babu Hanuman Prasad, Sub-Assistant Superintendent, 3rd grade, from 15th November 1896.
Babu Govind Balwant Joshi, Computer.
" Lal Singh "

379. The latitude of this point had been determined by Lieutenant Lenox-Conyngham in 1890-91 by observations taken with the zenith telescope by Talcott's method, and the resulting value judged by its probable error, was all that could be desired. It was, however, subsequently pointed out by Mr. Michie Smith, the Government Astronomer, that this value differed more largely from the previously accepted one than could well be accounted for by the inferiority of earlier methods of determination. Captain Burrard was therefore instructed to proceed to Madras and reobserve the value, taking with him both the zenith telescope used by Lieutenant Lenox-Conyngham and the zenith sector which had been

*Mr. Penrose and Mr. F. S. Bell have both performed their duties satisfactorily.
The following members of the native establishment are also deserving of special mention:—
Futteh Mahomed, Jonardhan Rao, Karimullah Khan, Krishnaji Mahadeo, Srikrishto Dey, Golam Hyder Khan, Mahomed Tabrez Khan, Jowala Pershad, Shoshi Bhusan, Nasiruddin, Nilmadhab, Kedarnath, and Bahadur Singh.

previously in use in the department for the determination of latitudes. Captain Burrard built a new pillar for the zenith sector and set up the zenith telescope on the same pillar that Lieutenant Lenox-Conyngham had previously observed from. This pillar was one which had been erected and used by the American observers in 1881 when determining the difference of longitude between Madras and Singapore.

It was composed of three solid cylindrical granite blocks superimposed and cemented together and was to all appearances of ideal construction. Soon after commencing observations, it became evident to Captain Burrard that the stability of the instrument on this pillar was more than doubtful, and that the level of the instrument changed with the position of the observer. This was traced to the fact that there was no depth of foundation to the pillar, the lowest stone being merely imbedded a couple of inches in the ground. Captain Burrard minimised this unsteadiness by observing from a wooden flooring, quite detached from the pillar, but the observations taken cannot be depended on for final accuracy. It is impossible now to say in what way this unsteadiness was got rid of by the American observers, but no doubt they managed to take such precautions as to obtain satisfactory results.

Captain Burrard's observations with the zenith sector were all that could be desired; the instrument working with perfect steadiness, and the resulting latitude, *viz.*, 13° 4′ 7″·94 is in very close agreement with the previously accepted value.

A further check on this has since been obtained by Mr. Michie Smith, the Government Astronomer, by observing the altitude of the sun on the meridian over a period of several months, the observations being taken both north and south of the zenith.

Combining all the reliable results, a value for the latitude of the Madras Observatory of 13° 4′ 8″·02 is arrived at, which may be accepted as final.

TIDAL AND LEVELLING OPERATIONS.

No. 25 Party.

380. The direction of these operations remained in the hands of Captain C. C. D. Morice, R.E., until 15th December 1896, when having applied to revert to home service he was succeeded by Captain S. G. Burrard, R.E. Captain Burrard took three months privilege leave from July 9th, Mr. G. Belcham holding charge during his absence. The staff has been strengthened during the past year by the addition of a Sub-Assistant Superintendent.

Personnel.

Captain S. G. Burrard, R.E., Offg. Superintendent, 2nd grade, in charge from December 16th, privilege leave from 9th July to September 28th and from October 14th to October 22nd.
" C. C. D. Morice, R.E., Deputy Superintendent, 2nd grade, in charge up to 15th December.
Mr. G. Belcham, Extra Assistant Superintendent, 1st grade, in charge from 9th July to 22nd October.
" E. J. Connor, Extra Assistant Superintendent, 4th grade.
" J. Bond, " " 4th grade.
" J. P. Barker, Sub-Assistant Superintendent, 1st grade, joined 2nd January.

Surveyors, etc.

Dhondu Venayek, Venayek Narayen, N. V. Apte, 3 Native Mechanics, 15 Recorders and Computers.

Tidal Operations.

381. The recording of the tidal curves by the self-registering tide-gauges, their reduction and the publication of the tables of predicted tides have continued as usual during the past year. In order to present the scheme of tidal operations in a connected form a complete list of the 41 observatories is given below: of these, twenty-six have now been closed on the completion of their registrations, twelve continue working and three are to be opened during the coming winter. The seven stations, the names of which are italicised, are permanent

stations, whilst the others are minor stations at which only five years registrations are required :—

	Stations.	Automatic or Personal observations.	Date of commencement of observation.	Date of closing of observations.	Number of years of observations.	Remarks.
1	Suez	Automatic	1897	Still working	...	
2	Perim	Ditto	...	...	...	Will open in 1898.
3	*Aden*	Ditto	1879	Still working	17	
4	Muscat	Ditto	1893	Ditto	4	
5	Bushire	Ditto	1892	Ditto	4	
6	*Kurrachee*	Ditto	1881	Ditto	16	
7	Hanstal	Ditto	1874	1875	1	
8	Navánagar	Ditto	1874	1875	1	
9	Okha Point	Ditto	1874	1875	1	
10	Porbandar	Personal	1893	1894	2	
10A	Ditto	Automatic	...	...	...	Will open in 1898.
11	Port Albert Victor (Káthiáwár).	Personal	1881	1882	1	
11A	Ditto ditto	Automatic	...	...	...	May open in 1898.
12	Bhávnagar	Ditto	1889	1894	5	
13	*Bombay (Apollo Bandar)*	Ditto	1878	Still working	19	
14	Bombay (Prince's Dock)	Ditto	1888	Ditto	9	
15	Mormugáo (Goa)	Ditto	1884	1889	5	
16	*Kárwár*	Ditto	1878	1883	5	
17	Beypore	Ditto	1878	1884	6	
18	Cochin	Ditto	1886	1892	6	
19	Tuticorin	Ditto	1888	1893	5	
20	Minicoy	Ditto	1891	1896	5	
21	Galle	Ditto	1884	1890	6	
22	Colombo	Ditto	1884	1890	6	
23	Trincomalee	Ditto	1890	1896	6	
24	Pámban Pass	Ditto	1878	1882	4	
25	Negapatam	Ditto	1881	1888	6	The year 1884-85 is excluded.
26	*Madras*	Ditto	1880 Restarted 1895	1890 Still working	10 2 } 12	
27	Cocanada	Ditto	1886	1891	5	
28	Vizagapatam	Ditto	1879	1885	6	
29	False Point	Ditto	1881	1885	4	
30	Dublat (Saugor Island)	Ditto	1881	1886	5	
31	Diamond Harbour	Ditto	1881	1886	5	
32	*Kidderpore*	Ditto	1881	Still working	16	
33	Chittagong	Ditto	1886	1891	5	
34	Akyab	Ditto	1887	1892	5	
35	Diamond Island	Ditto	1895	Still working	2	

	Stations.	Automatic or Personal observations.	Date of commencement of observation.	Date of closing of observations.	Number of years of observations.	Remarks.
36	Elephant Point	Automatic	1880 Restarted 1884.	1881 1888	1 } 6 5 }	
37	*Rangoon*	Ditto	1880	Still working	17	
38	Amherst	Ditto	1880	1886	6	
39	Moulmein	Ditto	1880	1886	6	
40	Mergui	Ditto	1889	1894	5	
41	*Port Blair*	Ditto	1880	Still working	17	

No observatories were closed during the year 1896-97. In 1897-98 it is intended to dismantle the observatory now existing at Muscat and possibly also that at Bushire, and to open new observatories at Perim, Porbandar and perhaps Port Albert Victor.

382. In addition to the automatic registrations made at the stations enumerated above, personal tidal observations to graduated staves were taken daily at the following closed tidal stations, *viz.*, Bhávnagar, Cochin, Tuticorin Colombo, Chittagong, Akyab and Moulmein. These readings were noted with the object of comparing the actual heights and times of high and low water with those predicted in the Tide Tables. No such comparisons have ever been made at Okha Point, Mormugáo, Kárwár, Beypore, Minicoy, Galle, Trincomalee, Pámban, Negapatam, Cocanada, Vizagapatam, False Point, Dublat, Diamond Harbour, Elephant Point, Amherst and Mergui since their observatories were closed, and it is not known if the predictions still continue accurate.

383. All the tidal observatories but three were inspected during the past year either by Captain Burrard or Mr. Belcham; the intended inspections of Kurrachee, Muscat and Bushire being stopped by the stringency of the quarantine regulations. No one of these stations however particularly needed inspection, and all will be visited early this season. Portable meteorological instruments were taken on the tours of inspection and compared with those working locally.

384. The tidal observatories have all worked satisfactorily with the exception of Diamond Island, where the registrations from the 21st January to the 9th March were irregular and incorrect, owing to the pipe and sluices being choked by barnacles. Free communication was eventually restored by inserting iron rods set with gimlets, but it is doubtful if the pipe will remain clear for any length of time.

The observatory clerks have performed their duties well, and the Port Officers, Port Engineers and other officials at the various stations have co-operated heartily.

385. The reduction of the observations has made good progress during the year, and the usual work in connection with the timely issue of the Tide Tables for 1898 has been satisfactorily got through. The Tide Tables now contain the predictions of high and low water at 37 ports.

The number of tides at present subjected to analysis is thirty-three, namely,

10 semi-diurnal tides,
7 diurnal tides,
7 over-tides,
4 compound tides,
2 fortnightly tides,
1 monthly tide,
1 six-monthly tide,
1 annual tide.

There is also a 19-yearly tide, but this has not yet been investigated at any of the Indian stations. At Professor Darwin's suggestion it is now proposed to evaluate the tide with a period of 427 days. Chandler, the American Astro-

nomer, has shown that there is a movement of the earth's axis of rotation round the pole in a small circle with a period of 427 days, and this change in the axis of rotation must produce a tide of that period. There are very few places in the world in which tidal observations have been carried on for a long enough time and with sufficient accuracy for the investigation, but the observations at two or three of the Indian ports are well suited for the purpose.

386. In the following statement are summarised the errors in the predicted heights and times of high and low water for the last three years.

Percentage of time predictions within 15 minutes of actuals :—

Situation and number of Stations.	Automatic.	1894.		1895.		1896.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
Open Coast 10	Auto.	65	62	66	63	70	68
Riverain 2	Do.	56	55	59	55	56	55.

Percentage of height predictions within 8 inches of actuals :—

Open Coast 10	Auto.	95	92	96	93	96	95
Riverain 2	Do.	66	42	74	47	63	42

Percentage of height predictions within one-tenth of mean range at springs :—

Open Coast 10	Auto.	97	95	91	89	94	90
Riverain 2	Do.	88	80	94	84	87	74

387. The station at which the predictions are most inaccurate is Bushire and this it may be remarked is the only Indian tidal station situated in an inland sea; it has however locally a very suitable site, on the open end of a peninsula unencompassed by shoals or islands, and the inaccuracies referred to must be attributed to the sea level of the gulf being irregularly affected by winds and pressure. It can hardly be questioned that the tide at Bushire is derived from the primary tide of the Indian Ocean: the Persian Gulf has an area of only 70,000 square miles and a depth never greater than 250 feet, and its waters cannot be directly affected by the sun or moon. In Lake Michigan, which is somewhat smaller than the Persian Gulf, the tidal range is only $1\frac{3}{4}$ inches and in the Mediterranean which is ten times as large it is only 1·2 inches, whilst at Bushire it is 4·8 feet. The anomaly however exists that the age of the tide at Bushire is less than at Muscat and that spring tide occurs at Bushire before it does at Muscat, although the tidal wave as shown on the cotidal chart reaches Muscat 12 hours earlier than Bushire. Attention is drawn to these peculiarities at Bushire as it may be found advisable this winter, if the predictions prove again inaccurate, to postpone the closing of its observatory.

Percentage of time predictions at Bushire within 15 minutes of actuals :—

	1895.		1896.	
	H. W.	L. W.	H. W.	L. W.
Open Coast Station	45	41	58	44

Percentage of height predictions within 8 inches of actuals.

	1895.		1896.	
	H. W.	L. W.	H. W.	L. W.
Open Coast Station	80	54	77	[illegible]

Percentage of height predictions within one-tenth of mean range at springs :—.

	1895.		1896.	
	H. W.	L. W.	H. W.	L. W.
Open Coast Station	69	45	73	62

388. The tides of the Red Sea, another inland sea, are not well understood, and are now about to be brought under investigation. An observatory was opened at Suez in March 1897, and observations will be commenced at Perim in January 1898 The primary tide of the ocean is apparently only felt at the southern end of the Red Sea: in the Straits of Bab-el-Mandeb there is a tidal range of about 7 feet, 70 miles north of Perim it is only $2\frac{1}{2}$ feet, and at some places still further north it is imperceptible. At Massowah, Suakim and Jeddah

a single tide a day of about 18 inches at springs is said to have been observed, but at these places and throughout the northern half of the Red Sea the level of the water will vary by as much as 3 feet according to the force and direction of the prevailing wind, and in the presence of this peculiarity but little weight can be attached to the result of a few tidal observations made with no pretence to refinement. As an example of the extent to which the tides of the Red Sea may be masked by the effects of wind, it is only necessary to mention the Dædalus shoal in latitude 25° where the steamers 'Carnatic' and 'Dacca' were wrecked: from December to March during the strong southerly winds this shoal is under water at all periods of the tide, whilst throughout the summer it remains perfectly dry, the change of sea level being dependent on season. The Gulf of Suez is believed by nautical men to have a tide of its own; the moon is supposed to raise a wave in the Red Sea south of the Sinai Peninsula, and this wave advancing up the shallow narrow gulf has an enhanced effect at Suez where the tidal range of 8 feet is greater than at any other place in the Red Sea. The age of the tide when deduced from our observations will show if this theory is correct. The influence of the Red Sea tide is not felt in the Suez Canal north of the Bitter Lakes. At Suez the flood stream lasts seven hours and the ebb stream five hours, a difference said to be due to the evaporation from the broad surface of the Bitter Lakes.

389. The Tidal diagrams for June 12th were closely searched for marks of the great earthquake: at Kidderpore the first effect of the earthquake was to cause the level of the water to fall one inch between 4-53 P.M. and 4-55 P.M. Calcutta time. At 4-55 P.M. there was a sudden rise of half an inch. For the next five minutes the change in the water-level was normal, but at 5 P.M. a series of oscillations commenced, the surface of the river alternately rising and falling three inches a great number of times, in rapid succession. After the first three minutes the range of these vibrations did not exceed one inch, and their intervals of recurrence became longer, the undulatory period being perhaps as much as a minute, till at 5-21 P.M. the commotion ceased. From 5-21 P.M. to 5-54 P.M. the water-level merely underwent its normal tidal change; a slight agitation then appeared again, but this subsided at 5-56 P.M.

The earthquake made no impression on the tidal diagrams at Port Blair, Diamond Island, Madras or Bombay. At Rangoon a slight perturbation is indicated on June 12th at about 5-5 P.M. Calcutta time, but that it was caused by the earthquake, is very doubtful. Chittagong is the port that probably witnessed the greatest disturbance of sea-level, but its tidal observatory was closed in 1891.

SPIRIT-LEVELLING OPERATIONS.

390. The regular levelling operations were carried out by Mr. J. Bond who had been instructed to continue work on the great line of levels that is to connect Vizagapatam and Allahabad.

The portion of this line between Biláspur and Ráipur was completed in 1891-92, that between Ráipur and Potanghi in 1895-96 and Vizagapatam had been connected with Vizianagram in 1894-95. A gap of 60 miles between Vizianagram and Potanghi had been left unfinished in May 1896, and the northern section from Biláspur to Allahabad had not been touched.

391. In November 1896, Mr. Bond after first connecting the two ends of the Vizagapatam Base line with the main line of levels, proceeded to observe from Potanghi to Vizianagram. This work in four weeks he completed and direct connection was thus established between Vizagapatam and Bilászpur.

He then moved *viâ* Calcutta to Bilászpur and commenced operations on the northern section. After three months work here, he closed his field season at Katni on May 11th, 1897, by which date he had extended the line from Bilászpur to within 150 miles of the terminus at Allahabad.

Branch lines were carried to five principal stations of the East Coast and Bilászpur Meridional Series and to the several shafts of the Umaria Colliery.

392. The total rises and falls of the country levelled over amounted to 12,818 feet, and the total outturn which is very creditable to Mr. Bond was 291½ miles of double levelling.

The instruments were set up at 3,239 stations, and the heights of 23 embedded bench-marks, 298 ordinary bench-marks, 72 Railway bench-marks, 8

verificatory points and 5 stations of the Great Trigonometrical Survey were determined.

Accepting the value assigned by the Trigonometrical Branch office to the embedded bench-mark at Ráipur, the error generated in levelling from Vizagapatam to Ráipur, a distance of 358 miles is +0·029 of a foot.

393. During next field season Mr. Bond and his detachment are to be employed in revising the triangulation of the Gáro and Khásia Hills for the purpose of measuring the changes which it is believed have been caused by the earthquake, and the levelling operations will be held in abeyance.

394. In addition to the regular departmental work of the tidal and levelling party, a considerable amount of extra work had to be undertaken in order to furnish other departments and Local Governments with information applied for by them.

395. The recess office of this party at Poona was visited by the Surveyor-General in September 1897. The annual inspection by the Superintendent of Trigonometrical Surveys was carried out in October 1896.*

*Captain Burrard reports most favourably of Messrs. Belcham, Connor and Barker and Surveyor Dhondu Vinayek in the tidal division, and of Mr. Bond and Surveyor Vinayek Narayen in the levelling division. The staff of mechanics, sub-surveyors and computers are reported to have worked well.

Summary of the outturn of work of the

Scale of Survey.	No. of Party.	Locale of field operations.	Triangulation. Instrument used. Diameter in inches.	Triangulation. Area, in square miles.	Triangulation. Square miles to each point trigonometrically fixed.	Triangulation. Square miles to each height.	Secondary. Stations fixed.	Secondary. Triangular error in seconds.	Secondary. Error per mile in feet.	Tertiary. Intersected points.	Tertiary. Error per mile in feet.	Spirit-levelling operations. Miles levelled over.	Spirit-levelling operations. Permanent bench-mark stones embedded.	Spirit-levelling operations. Trigonometrical stations connected with.
Inches to a mile. 105·6	7	Rangoon Town	...	...	...	...	...	...	...	...	...	...	...	...
52·8		Do. do.	...	...	...	...	...	...	...	...	...	...	...	...
		Total	...	...	...	...	...	...	...	...	...	...	...	...
66	12	Kurrachee City	...	...	...	...	...	...	...	...	...	...	...	...
32	4	Midnapore	...	...	...	...	...	...	...	...	...	...	...	...
16	2	Kheri	...	...	...	...	...	...	...	...	...	...	...	...
		Shahjahanpur	...	...	...	...	...	...	...	...	...	...	...	...
		Pilibhit	...	...	...	...	...	...	...	...	...	...	...	...
	3	Shwebo	12	...	...	...	...	...	...	...	...	...	...	...
		Yamethin	...	...	...	...	...	...	...	...	...	...	...	...
		Katha	...	...	...	...	...	...	...	...	...	...	...	...
		Upper Chindwin	...	...	...	...	...	...	...	...	...	...	...	...
		Myingyan	...	...	...	...	...	...	...	...	...	...	...	...
		Minbu	...	...	...	...	...	...	...	...	...	...	...	...
		Mandalay	...	...	...	...	...	...	...	...	...	...	...	...
		Lower Chindwin	...	...	...	...	...	...	...	...	...	...	...	...
	4	Noakhali	...	...	...	...	...	...	...	...	...	...	...	...
		Muzaffarpur	...	...	...	...	...	...	...	...	...	...	...	...
		Saran	...	...	...	...	...	...	...	...	...	...	...	...
		Darbhanga	...	...	...	...	...	...	...	...	...	...	...	...
		Monghyr	...	...	...	...	...	...	...	...	...	...	...	...
	7	Pegu	5	...	...	...	...	...	...	...	...	...	...	...
		Toungoo	5 & 6	...	...	...	...	...	...	...	...	...	...	...
	8	Gonda	...	...	...	...	...	...	...	...	...	...	...	...
		Meerut	...	...	...	...	...	...	...	...	...	...	...	...
		Bareilly	...	...	...	...	...	...	...	...	...	...	...	...
		Bijnor	...	...	...	...	...	...	...	...	...	...	...	...
	15	Baluchistan	5	...	...	...	...	...	...	...	...	...	...	...
	17	Bombay (Forests)	...	...	...	...	...	...	...	...	...	...	...	...
	Forest Branch.	Nagpur and Wardha	...	...	...	...	...	...	...	...	...	...	...	...
		Balaghat	...	...	...	...	...	...	...	...	...	...	...	...
		Seoni	...	...	...	...	...	...	...	...	...	...	...	...
		Chhindwara	...	...	...	...	...	...	...	...	...	...	...	...
		Raipur	...	...	...	...	...	...	...	...	...	...	...	...
		Saugor	...	...	...	...	...	...	...	...	...	...	...	...
	Land Records Survey.	Meerut	...	...	...	...	...	...	...	...	...	...	...	...
		Lalitpur subdivision	...	...	...	...	...	...	...	...	...	...	...	...
		Bahraich	...	...	...	...	...	...	...	...	...	...	...	...
		Sitapur Alluvial Mahals	...	...	...	...	...	...	...	...	...	...	...	...
		Shajahanpur	...	...	...	...	...	...	...	...	...	...	...	...
		Kheri	...	...	...	...	...	...	...	...	...	...	...	...
		Bareilly	...	...	...	...	...	...	...	...	...	...	...	...
		Total	...	...	...	...	...	...	...	...	...	...	...	...
12	15	Baluchistan	8 & 6	1,940 (e)	3·2	3·4	102	4·2	0·12	1,527	0·26	...	...	...
8	3	Katha	...	...	...	...	...	...	...	...	...	...	...	...
	17	Bombay (Forests)	7	1,376 (f)	...	...	37	8·0	0·2	210	0·2	...	...	...
		Total	...	1,376	...	...	37	...	...	210	...	...	...	...
6	15	Rawalpindi	...	...	...	...	...	...	...	...	...	...	...	...

Field Parties during the year 1896-97.

	TRAVERSING.				DETAIL SURVEY.					RECORD-WRITING.			REMARKS.
	Area, in square miles.	Stations at which theodolite was set up.	Angular error per station in seconds.	Linear error per mille.	Area, in square miles.	Plane-table fixings per square mile.	Linear miles of test lines.	Villages.	Average size of fields.	Area, in square miles.	Villages.	Fields.	
...	} 5·25	2,580	10	0·6 {	1·38	...	52	8	...	...	...	7,084(a)	
...					4·58	...	53	11	...	...	...	21,118(a)	
...	5·25	2,580	...	...	5·96	...	105	19	...	...	...	28,202	
...	...	331	...	...	1·41	...	10	...	...	...	...	...	
...	4	225	...	...	3	...	31	8	0·27	3	8	7,860	
5	1,600	21,503	4	0·63	...	...	...	...	...	...	...	...	
...	237	5,165	4	0·66	...	...	...	...	...	...	...	...	
...	1,168	18,834	4	0·66	...	...	...	...	...	...	...	...	
...	...	...	...	...	46	...	39	22	5·74	...	...	5,053(a)	
...	16	247	...	...	56	...	26	34	3·42	...	...	10,551(a)	
10	186	12,794	0·5	0·46	229	...	584	616	0·55	...	...	267,235(a)	
...	46	2,420	...	...	129	...	388	317	0·33	...	...	244,535(a)	
...	881	10,014	0·2	0·26	781	...	2,033	782	2·18	...	...	230,161(a)	
...	151	7,064	0·4	0·35	57	...	141	160	0·74	...	...	49,940(a)	
...	...	...	...	...	2	...	3	7	0·20	...	...	6,783(a)	
15	482	10,080	0·03	0·42	...	...	...	...	...	...	...	...	
...	226	1,559	...	...	230 (b)	...	447	66	1·11	84	43	48,342	
...	2	71	...	...	2	...	2	2	0·85	2	2	961	
...	60	1,059	...	...	235 (c)	...	1,384	385	0·32	210	330	412,843	
...	417	10,886	...	...	585 (d)	...	2,407	661	0·32	545	638	1,091,765	
20	...	...	...	...	1	...	...	2	2·34	1	2	232	
...	11	214	2	1·3	450	...	1,244	188	0·56	...	...	209,490(a)	
...	679	14,029	5	0·4	59	...	328	20	0·44	...	...	73,680(a)	
...	1,004	16,452	4	0·2	...	...	...	...	...	...	...	...	
...	175	1,675	7	0·34	...	...	...	...	...	...	...	...	
25	744	11,776	3	0·19	...	...	...	...	...	...	...	...	
...	403	7,326	2	0·1	...	...	...	...	...	...	...	...	
...	...	802	8	1·0	...	...	...	...	...	...	...	...	
...	...	...	...	...	33	8	42	...	...	...	...	...	
...	...	...	...	...	42	25	22	...	...	...	...	...	
30	...	...	...	...	35	83	...	...	...	...	...	...	
...	...	...	...	...	22	...	...	...	...	...	...	...	
...	...	...	...	...	41	...	...	...	...	...	...	...	
...	...	...	...	...	19	...	...	...	...	...	...	...	
...	...	...	...	...	47	...	...	...	...	...	...	...	
35	...	...	...	...	593	...	...	479	0·9	801	616	531,861	
...	...	...	...	...	501	...	...	224	2·4	501	224	129,353	
...	...	...	...	...	914	...	...	640	0·7	841	638	1,002,471	
...	...	...	...	...	62	...	...	47	1·1	62	47	35,090	
...	...	...	...	...	806	...	...	1,184	0·8	806	1,184	624,257	
40	...	...	...	...	755	...	...	654	0·9	755	654	500,842	
...	...	...	...	...	694	...	...	957	0·7	515	724	464,691	
...	8,488	153,970	...	...	7,426	...	9,090	7,447	...	5,123	5,102	5,940,136	
...	...	...	...	...	56	358	36	...	...	...	...	...	
...	...	...	...	...	2	406	...	...	...	...	...	...	
...	...	...	...	...	168	197	70	...	...	...	...	...	
...	...	...	...	...	170	...	70	...	...	...	...	...	
45	...	...	...	...	21	148	*in situ*	...	...	...	...	...	

(a) Fields marked (a) are of detail survey, and not of record-writing.
(b) Includes 23 villages = 146 square miles of topographical survey on 16" scale.
(c) Includes 55 villages = 25 square miles of topographical survey on 16" scale.
(d) Includes 23 villages = 40 square miles of topographical survey on 16" scale.
(e) This includes the triangulation done for 6-inch survey in Rawalpindi.
(f) Includes 1,041 square miles done for 4-inch Survey. Excludes 141 square miles of triangulation done in Surat which has not yet been computed.
(g) Includes 10 square miles done for the 8-inch scale.
(h) The triangulation includes that done for the 2" detail survey.
(i) Includes 191 square miles of forest blocks.
(j) Includes 623 square miles of Traversing done for 2" detail topographical survey.
(k) Includes 41 square miles of resurvey of Sittang River.
(l) One hundred and fifty-six square miles of overlap not included in calculating cost rates.
(m) Includes 036 square miles of overlap survey.
(n) Includes 454 square miles of overlap and riverain survey.
(o) Includes 277 square miles of overlap survey.

Summary of the outturn of work of the

Scale of Survey.	No. of Party.	Locale of field operations.		Triangulation. Instrument used. Diameter in inches.	Area, in square miles.	Square miles to each point trigonometrically fixed.	Square miles to each height.	Secondary. Stations fixed.	Triangular error in seconds.	Error per mile in feet	Tertiary. Intersected points.	Error per mile in feet.	Spirit-levelling operations. Miles levelled over.	Permanent bench-mark stones embedded.	Trigonometrical stations connected with.
Inches to a mile.															
4	9 {	Trichinopoly	...	6	250	2·0	2·2	38	5·9	5·9	85	3·8	...	...	...
		Coimbatore	...	6	1,200	4·8	4·8	...	...	...	251	1·1	...	...	...
	14	Central Provinces (Forests).	...	6	1,770	4·0	4·0	83	10·0	0·35	261	1·04	...	...	...
	17	Bombay (Forests)	...	6	...	...	...	...	...	...	...	...	...	...	...
	18	Himalaya	5	7	202(*h*)	0·64	0·64	19	3·2	0·27	449	0·24	...	...	...
	19	North Arcot, Kurnool, Salem.	...	5 & 7	1,000	2·6	2·6	143	17	0·6	319	0·67	...	...	..
	20	Burma (Forests)	...	5	...	...	...	...	...	...	...	...	...	...	...
	Forest Branch.	Saugor	...	7	327	14·2	13·1	5	...	7	...	...	...	...	...
		Raipur	...	5	...	...	...	...	...	...	...	...	...	...	...
		Nagpur	10	...	...	...	...	...	...	...	...	...	...	...	...
		Balaghat	...	...	...	...	...	...	...	...	...	...	...	...	...
		Seoni	...	...	...	...	...	...	...	...	...	...	...	...	...
		Chhindwara	...	...	...	...	...	...	...	...	...	...	...	...	...
		Bilaspur	...	...	...	...	...	...	...	...	...	...	...	...	...
		Chamba	15	...	...	...	...	...	...	...	...	...	...	...	...
		Yamethin (Pyinmana)	...	5	...	...	...	...	...	...	...	...	...	...	...
		Tenasserim	...	8, 7, 5 & 4½	523	6·8	6·8	17	9·9	0·41	60	0·97	...	...	...
		Ruby Mines	...	10, 7, 5½, 5 & 4½	1,712	38·6	38·6	11	20·7	0·26	23	2·48	...	...	...
		Totals	...	...	6,984	...	...	316	...	...	1,448	...	...	...	...
2	4	Noakhali	...	...	...	...	...	...	...	...	...	...	...	...	...
	6 {	Goalpara	20	...	...	...	...	...	...	...	...	...	...	...	...
		Kamrup	...	...	...	...	...	...	...	...	...	...	...	...	..
		Sylhet	..	...	...	...	...	...	...	...	...	...	...	...	...
	7	Thaton	...	...	...	...	...	...	...	...	..	...	...	...	...
	12	Sind	...	8, 6 & 5	...	...	...	90	10·0	...	43	6·4	...	...	...
	15	Multan	25	5	...	...	...	...	...	...	...	...	...	...	...
	18	Himalaya	...	...	...	...	...	...	...	...	...	...	...	...	...
	20	Burma (Forests)	...	...	...	...	...	...	...	...	...	...	...	...	...
		Totals	...	...	...	...	...	190	...	...	43	...	..	...	...
1	10	Upper Burma	...	6	2,503	7·5	26·4	50	10·9	0·33	297	0·82	...	..	...
	11	Do. do.	...	6	3,220	5·3	5·4	93	13·0	0·22	515	0·52	..	...	...
	15	Sind	30	...	...	...	...	...	...	...	...	...	...	...	...
	21	Upper Burma	...	8 & 6	2,967	8·0	12·1	50	10·9	0·33	297	0·82	...	...	...
	Forest Branch.	Chamba	...	...	...	...	...	...	...	...	...	..	...	...	...
		Totals	...	...	8,690	...	...	193	...	...	1,109	...	...	...	..
½	15	Baluchistan	...	...	..	...	...	...	...	...	...	...	...	...	...
¼	11	Upper Burma	...	6	2,000	...	...	...	...	...	...	...	...	...	...
	21	Do. do.	35	...	...	...	...	...	...	...	...	...	...	...	...
		Totals	...	...	2,000	...	...	...	...	...	...	...	...	...	...
⅛	15	Persia	...	...	...	...	...	...	...	...	...	...	...	...	..
	25	India	37	...	...	...	...	...	...	...	...	...	291	329	5
		Totals		...	...	...	...	...	..	...	...	..	291	329	5
		GRAND TOTALS	...	...	20,990	...	...	738	...	...	4,337	...	291	329	5

Field Parties during the year 1896-97—(contd).

	TRAVERSING.				DETAIL SURVEY.					RECORD-WRITING.			REMARKS.
	Area, in square miles.	Stations at which theodolite was set up.	Angular error per station in seconds.	Linear error per mile.	Area, in square miles.	Plane-table fixings per square mile.	Linear miles of test lines.	Villages.	Average size of fields.	Area, in square miles.	Villages.	Fields.	
...	...	2,053	0·10	0·94	121	45	18	...	...	...	...	...	
...	...	2,262	0·15	...	...	...	...	...	...	...	...	...	
...	408	2,753	10·0	...	697	79	412	...	...	...	...	...	
...	244(g)	1,096	0·07	1·0	522	24	35	...	...	...	...	...	
5	...	...	...	...	446(i)	48	*in situ*	...	...	...	...	...	
...	...	...	...	...	1,027	{ 81 52	{ 25 in Arcot 192 in Salem }	...	...	...	...	...	
...	512	13,100	2·8	2·7	395	189	147	...	...	...	...	...	
...	...	...	...	...	185	130	365	...	...	...	...	...	
...	11	105	...	2·2	146	113	764	...	...	...	...	...	
10	...	...	...	...	183	216	132	...	...	...	...	...	
...	...	...	...	...	133	215	19	...	...	...	...	...	
...	...	...	...	...	157	149	45	...	...	...	...	...	
...	...	...	...	...	178	216	52	...	...	...	...	...	
...	...	...	...	...	20	82	...	...	...	...	...	...	
15	...	...	...	...	87	70	*in situ*	...	...	...	...	...	
...	...	1,671	3·0	0·46	171	23	110	...	...	...	...	...	
...	33	1,113	6·0	...	97	227	72	...	...	...	...	...	
...	49	3,054	3·8	..	...	...	..	...	...	...	...	...	
...	1,257	27,207	...	...	4,565	..	2,388	...	...	...	...	...	
...	199	689	...	...	199	...	43	8	...	...	...	...	
20	}			{	6	...	...	...	...	...	...	...	
...	} 1,433 (j)	22,591	3·7	0·7 {	623	...	...	...	...	...	...	...	
...	}			{	...	..	...	...	...	...	...	...	
...	21	645	3·0	0·6	493(k)	3	6	...	...	...	...	...	
...	3,635	14,736	3·1	0·9	2,244(l)	20	34	...	...	...	...	...	
25	735	1,691	11·4	0·7	912	14	114	...	...	...	...	...	
...	...	...	...	...	364	...	...	...	...	...	...	...	
...	...	...	...	...	106	56	21	...	...	...	...	...	
...	6,023	40,352	...	...	4,947	...	218	8	...	...	...	...	
...	...	...	...	...	1,961(m)	5·9	*in situ*	...	...	...	...	...	
...	...	...	...	...	1,649(n)	7·0	49	...	...	...	...	...	
30	...	...	...	...	1,825	3·0	163	..	...	...	...	...	
...	...	...	...	...	2,137(o)	5·9	*in situ*	...	...	...	...	...	
...	...	...	...	...	802	16·0	do.	...	...	...	...	...	
...	...	...	...	...	8,374	...	212	...	...	...	..	...	
...	...	...	..	...	700	0·3	...	...	...	...	...	...	
...	...	...	...	...	8,170	...	...	...	...	...	...	...	
35	...	...	...	...	3,548	...	...	...	...	...	...	...	
...	...	...	...	...	11,718	...	...	...	...	...	...	...	
...	...	...	...	...	67,000	...	...	...	...	...	...	...	
37	...	...	...		...	...							
...	...	...	...	...	...	...	...	...	...	...	...	...	
...	15,777·25	2,24,6[illegible]5	...	...	1,04,987·37	...	12,160	7,482	...	5,126	5,110	59,76,198	

Statement showing the cost-rates of work executed by the

Number of party.	Nature and *locale* of field operations.	COST-RATE PER SQUARE MILE IN RUPEES.												
		Triangulation.	Traversing.	Detail survey and preparation of maps on scales of										
				⅛"	¼"	½"	1"	2"	4"	6"	8"	12"	16"	32"
		R	R	R	R	R	R	R	R	R	R	R	R	R
	Topographical Surveys.													
6	Goalpara and Kamrup . .	...	29·3	...	...	...	...	43·7	...	...	...	...	...	...
10	Upper Burma . . .	14·9	...	...	...	...	31·8	...	...	...	...	...	...	...
11	Ditto	9·7	...	...	...	...	46·3	...	...	...	...	...	...	...
12,	Sind	...	9·1	...	...	...	...	14·2	...	...	...	...	...	...
15	Baluchistan, Rawalpindi, Persia.	12"=133·31; 6"= 28·0; 1"= 9·25	14·6	6·0	...	4·2	7·0	15·7	...	15·[illegible]	...	176·0	...	...
18	Himalayas . . .	29·7	...	...	...	...	...	48·7	93·3	...	...	...	...	...
21	Upper Burma . . .	10·5	...	...	3·5	...	21·3	...	...	...	...	...	...	...
	Forest Surveys.													
9	Madras	25·1		...	...	...	...	...	324·3	...	...	...	...	...
14	Central Provinces . . .	7·4	17·7	...	...	...	...	...	70·5	...	...	...	...	...
17	Bombay	7·4	8·1	...	...	...	...	...	77·6	...	135·7	...	156·0	...
19	Madras	17·4		...	...	...	...	...	65·4	...	...	...	...	...
20	Lower Burma . . .	...	81·8	...	...	...	...	51·1	169·8	...	...	...	...	...
Forest Survey Branch.	Balaghat and Seoni . .	...	...	...	...	...	...	...	37·0	...	...	...	...	...
	Chhindwara . . .	...	...	...	...	...	...	...	46·9	...	...	...	...	...
	Nagpur and Wardha .	...	...	...	...	...	...	...	37·4	...	...	...	...	...
	Raipur and Bilaspur .	...	...	...	...	...	...	...	10·1	...	...	...	53·7	...
	Saugor, Jubbulpore, and Mandla	...	...	...	...	...	...	...	9·4	...	...	...	46·7	...
	Chamba	...	...	...	...	...	8·5	...	29·8	...	...	...	...	...
	Tenasserim . . .	7·7	29·1	...	...	...	...	...	99·3	...	...	...	...	...
	Yamethin (Pyinmana) . .	...	45·1	...	...	...	...	...	105·2	...	...	...	...	...
	Ruby Mines . . .	7·7	33·4	...	...	...	...	...	...	...	...	...	...	...
	Cadastral Surveys.													
	Shwebo	...	...	...	...	...	...	...	...	...	...	...	161·4	...
	Yamethin	...	59·6	...	...	...	...	...	...	...	...	...	74·9	...
	Katha	...	66·1	...	...	...	...	...	...	...	...	...	104·2	...
3	Upper Chindwin . . .	...	85·6	...	...	...	...	...	...	...	...	...	130·4	...
	Myingyan	...	67·7	...	...	...	...	...	...	...	...	...	124·3	...
	Minbu	...	54·9	...	...	...	...	...	...		...	...	74·9	...
	Mandalay	...	...	...	...	...	...	...	...	...	...	...	75·0	...
	Lower Chindwin . . .	...	62·1		...	...	...	...	...	...	...	...	...	...
	Noakhali	...	32·1	...	...	...	...	6·0	...	...	...	...	89·0	...
4	Midnapore	...	98·8	...	...	...	...	...	...	...	...	...	...	302·7
	Saran	...	...	...	...	...	...	...	...	...	...	...	142·0	...
	Darbhanga	...	54·3	...	...	...	...	...	...	...	...	...	78·3	...
7	Pegu and Toungoo . .	...	63·9	...	...	...	...	58·5	...	...	...	...	150·8	...
	Traverse Surveys.													
	Shahjahanpur . . .	...	23·7	...	...	...	...	...	...	...	...	...	...	...
2	Kheri	...	23·7	...	...	...	...	...	...	...	...	...	...	...
	Pilibhit	...	23·7	...	...	...	...	...	...	...	...	...	...	...
8	Meerut, Bareilly and Bijnor .	...	24·1	...	...	...	...	...	...	...	...	...	...	...
	Gonda	...	30·6	...	...	...	...	...	...	...	...	...	...	...

several Field Parties during the year 1896-97.

	Cost-rate per acre in annas.	Cost-rate per square mile in Rupees.			Total cost, inclusive of charges for instruments to Provincial Governments.	Remarks.
	Cadastral survey, including traversing, detail survey and mapping.	Stone embedding.	Records (*Khanapuri*).	Completion of vernacular records, assessment statistics, etc.		
	Annas.	*R*	*R*	*R*	*R*	
...	...	...	...	...	79,540(*a*)	
...	...	...	...	...	92,317	
...	...	...	...	...	1,23,061	
...	...	...	...	...	94,683	
5	...	...	...	...	1,38,103	
...	...	...	...	...	63,826(*c*)	
...	...	...	...	...	89,383	
...	...	...	...	...	78,904	
...	...	...	...	...	89,135	
10	...	...	...	...	82,337	
...	...	...	...	...	87,782	
...	...	...	...	...	114,234	
...	...	...	...	...	12,853(*d*)	
...	...	...	...	...	10,262(*e*)	
15	...	...	...	...	9,697(*f*)	
...	...	...	...	...	13,330(*g*)	
...	...	...	...	...	15,161(*h*)	
...	...	...	...	...	9,731	
...	...	...	...	...	16,840	
20	...	...	...	...	21,728	
...	...	...	...	...	18,685	
...	4·03	...	...	10·8	7,923	
...	3·36	...	...	4·8	5,415	
...	4·26	...	...	6·9	37,739	
25	5·40	...	...	8·7	21,883	
...	4·80	...	...	8·3	163,199	
...	3·25	...	...	4·8	12,832	
...	1·88	...	...	4·5	159	
...	...	...	...	...	29,942	
30	3·03	2·5	36·5	22·0	20,890(*i*)	
...	10·04	...	199·3	...	2,070(*j*)	
...	3·55	...	63·0	65·6	66,897(*k*)	
...	3·31	0·5	43·5	44·0	1,30,285(*l*)	
...	5·37	5·3	...	...	1,98,796(*m*)	
35	...	3·4	...	...	6,437	
...	...	3·4	...	...	43,461	
...	...	3·4	...	...	31,726	
...	...	1·4	...	...	33,825	
39	...	2·9	...	...	33,654	

(*a*) Includes R3,562 expended on demarcation. Four per cent. for instruments have been added to R21,809 expended on Cachar revision survey, or cadastral mapping, statistics, etc., of Goalpara, Kamrup and Sylhet.

(*b*) Includes R4,858 expended on Karenni Boundary Survey and R31,511 expended on ¼" survey.

(*c*) Includes R984 expended on survey of the Town of Nahan; R233 on the revision of Simla Municipal map; R2,565 on the instruction of soldier surveyors and pupils; and R12,701, on arrears of mapping.

(*d*) Inclusive of the 16-inch work done in these districts—22 square miles in Seoni and 35 square miles in Balaghat.

(*e*) Inclusive of the 16-inch work done in this district—41 square miles.

(*f*) Inclusive of the 16-inch work done in this district—42 square miles.

(*g*) Inclusive of the 16-inch work done in this district—19 square miles; also R3,042 for levelling at R6·4 per mile.

(*h*) Inclusive of the 16-inch work done in this district—47 square miles; also R1,224 for levelling in Saugor.

(*i*) Includes R90 expended on completion of Backerganj records.

(*j*) Includes R169 expended on revision survey in Orissa.

(*k*) Includes R3,314 extended in bringing up arrears of Champaran records.

(*l*) Includes R9,002 expended on Monghyr records; R4,385 on Mozaffarpur records; R591 on Gaya records; R1,527 on Palamau records and R474 on Singhbhoom records.

(*m*) Includes R40,031 expended on survey of Rangoon Town; R3,324 on revision survey in district Thaton. The rate of 2-inch detail survey is for District Thaton only.

Particulars of Cadastral Surveys completed since 1895-96.

District.	Scale of survey.	Number of villages.	Number of fields.	Area surveyed.*	Average size of fields.	Cost, exclusive of demarcation and charge for instruments.	Rate per square mile. Traverse survey.	Rate per square mile. Cadastral survey.	Rate per square mile. Cadastral survey, with Record of Rights.	By whom and when surveyed.
				Sq. miles.	Acre.	R	R a. p.	R a. p.	R a. p.	
Shwebo	16"=1 mile	975	1,454,720	2,921	1·29	402,604	46 4 11	84 7 9	...	Messrs. G. B. Scott, G. H. Cooke and E. J. Jackson during 1891-97.
Yamethin	16"=1 mile	1,415	734,646	1,642	1·43	242,333	60 10 7	87 2 4	...	Ditto ditto ditto 1893-97.
Pegu	16"=1 mile	370	481,265	941	1·25	165,880	47 1 10	127 9 10	...	Messrs. C. Wood and B. G. Gilbert Cooper during 1894-97.
Meerut	16"=1 mile	1,724	1,935,521	2,367	0·78	135,890	21 2 7	...	35 7 6	Traverse Survey done by Capt. J. M. Fleming and Mr. J. S. Pemberton during 1895-97. Cadastral Survey done by Land Records Surveys.
Jhansi — Lalitpur Sub-Division	16"=1 mile	751	582,480	1,506	1·58	94,096	16 13 0	...	35 5 7	Traverse Survey done by Lt.-Col. J. E. Sandeman during 1888-90. Cadastral Survey done by Land Records Surveys.
Jhansi — Gursarai and Kakarbai Estate.	16"=1 mile	68	77,853	193	1·52	8,121	20 4 5	...	28 0 0	Traverse Survey done by Lt.-Col. J. E. Sandeman during 1889-90. Cadastral Survey done by Land Records Surveys.
Sitapur (Alluvial Mahals) . .	16"=1 mile	145	130,644	196	0·96	...	19 10 5	...	41 14 8	Traverse Survey done by Captain J. M. Fleming during 1895-96. Cadastral Survey done by Land Records Surveys.

PART III.

THE OPERATIONS AT THE HEAD-QUARTERS OFFICES.

396. These Offices comprise—

(1) The Head-Quarters Offices at Calcutta.
(2) The Trigonometrical Branch Office at Dehra Dun.
(3) The Drawing Office at Simla.
(4) The Forest Survey Branch Office at Dehra Dun.

A description of the work carried on in each office is given below :—

I.—HEAD-QUARTERS OFFICES, CALCUTTA.

SUPERINTENDENCE, CORRESPONDENCE AND ACCOUNTS.

Superintendence.

Major-General C. Strahan, R.E., Surveyor-General of India.
Colonel J. E. Sandeman, I.S.C., Deputy Surveyor-General, in charge Revenue Branch up to 18th April 1897.
Colonel M. W. Rogers, R.E., Assistant Surveyor-General up to 3rd February 1897.
Lieutenant-Colonel J. R. Hobday, I.S.C., Assistant Surveyor-General from 4th February 1897 and Officiating Deputy Surveyor-General in charge Revenue Branch from 19th April 1897.
Major F. B. Longe, R.E., Officiating Assistant Surveyor-General from 30th April 1897.
Mr. T. A. Pope, Personal Assistant to the Surveyor-General up to 30th April 1897.
Mr. T. W. Babonau, Registrar.

Correspondence.

Mr. T. A. Milne, Head Assistant.
„ G. C. Walker, Head Clerk.
Babu Kalipodo Banerji, Clerk.
„ Banimadhub Banerji, „
„ Chuni Lal Dey, „
„ Durga Narayan Ghose, „
„ Ramkristo Chunder, „
Mr. H. E. D'Cruz. „
Babu Gopal Chunder Dass, „
„ Kali Kristo Chunder, „
and twelve others.

Accounts.

Mr. C. O. Gray, Head Clerk.
Babu Rajkrishna Mukerji, Clerk.
Mr. E. A. Bonnaud, „
Babu Hem Nath Dutt, „
and seven others.

397. The general direction of these offices remained in the hands of Major-General C. Strahan, R.E., throughout the year. The Revenue Branch Section was under Colonel J. E. Sandeman, I.S.C., up to 18th April 1897 and thereafter under Lieutenant-Colonel J. R. Hobday, I.S.C. The General and Topographical Branch Sections were under Colonel M. W. Rogers, R.E., up to 3rd February 1897, under Lieutenant-Colonel J. R. Hobday, I.S.C., from 4th February to 29th April 1897, and under Major F. B. Longe, R.E., from 30th April 1897 to the close of the year. Mr. T. A. Pope held the office of Personal Assistant to the Surveyor-General up to 30th April 1897.

The Assistant Surveyor-General reports as follows :—

Mr. T. W. Babonau, Registrar, performed with credit the duties connected with the general superintendence of the office.

Messrs. Milne and Gray, especially the latter, have carried on satisfactorily the duties of their respective posts. The Native Clerks have also done well, and among them may be specially mentioned Babus Banimadhub Banerji, Chuni Lal Dey, Rajkrishna Mukerji, and Ram Kristo Chunder.

The Officiating Deputy Surveyor-General reports that in the Revenue Branch Office Mr. G. C. Walker, the Head Clerk, and Babus Kali Podo Banerji and Norendro Nath have continued to give satisfaction in the discharge of their duties.

DRAWING OFFICE.

398. The drawing office has been under the superintendence of Mr. A. E. Spring throughout the year under report. Mr. L. J. Pocock held the post of Chief Draftsman up to the 16th May 1897, when he was relieved of his duties by Mr. W. Stotesbury.

SECTION I.—GEOGRAPHICAL, DRAWING, AND COMPILATION.

399. During the year under review the two sheets 3 S.E. and 3A.N.E. of the South-East Frontier series, mentioned in paragraph 481 of the last Annual Report, as being in progress, were suspended for the completion of the headings and foot-notes of the maps of the Madras and Burma Forest Surveys submitted by the field parties, as these were urgently required by the district officials. For the same reason the progress of the eight 8-mile maps of the same series, referred to in paragraph 482 of the last Annual Report, was retarded to a certain extent, though the fair drawing of five of these sheets has been well advanced; the 5th edition of sheet No. 1 of the South-Eastern Frontier series being in course of publication, whilst sheets Nos. 9 and 10 of the same series have been published. In addition, sheets No. 15 N. W., on the 4-mile, and No. 15 (4th edition) on the 8-mile scale, of the North-Eastern Frontier series were published; whilst sheets No. 14 S. E., and parts of Nos. 23 N. E. and N. W. (in one sheet) on the 4-mile scale of the same frontier, were brought up to date with railway lines and changes to boundaries.

Personnel.

Mr. L. J. Pocock, Chief Draftsman up to 16th May 1897.
Mr. W. Stotesbury, Chief Draftsman, from 17th May 1897 (sub. *pro tem.*).

Extra Assistant Superintendents and Sub-Assistant Superintendents on duty.

Mr. A. J. Wilson, Extra Assistant Superintendent, 1st grade, from 19th July to 1st September 1897.
Mr. T. H. Rendell, Extra Assistant Superintendent, 3rd grade, from 20th November 1896.
Mr. J. A. Barker, Extra Assistant Superintendent, 4th grade.
Mr. G. E. Parker, Extra Assistant Superintendent, 5th grade, from 23rd October 1896.
Mr. E. P. S. Hill, Extra Assistant Superintendent, 6th grade, from 28th November 1896.
Mr. S. O. Madras, Sub-Assistant Superintendent, 1st grade.
Mr. P. L. Causley, Sub-Assistant Superintendent, 3rd grade, from 3rd April 1897.
Mr. W. Green, Draftsman.
" A. J. Musgrove, "
" J. R. Adels, "
" R. C. Sinclair, "
" A. S. Bateman, "
" A. J. Rodrigues, " up to 14th March 1897.
" A. J. Wilson, Draftsman.
" C. L. Green, " (sub. *pro tem.*), from 15th March 1897.
" E. A. Knight, Draftsman.

Native Draftsmen.

Babu Purna Chandra Sen.
Munshi Muttyullah.
" Rahim Bakhsh.
Babu Sarat Chandra Chatterjee.
" Narendra Nath Mukherjee.
" Subodh Chandra Sarkar.
" Sarat Chandra Coomar and 28 others.

400. Of the standard sheets of the topographical survey of Upper Burma on the 1-inch scale referred to in paragraph 483 of last year's report, No. 314 is under publication, and No. 358 has been published. A new sheet of this series, No. 306, was completed at the Head-Quarters Office, and published as a preliminary edition.

401. The general maps in hand were:—(i) The third edition of the 32-mile map of India, which will, in all probability, be published during the coming year; (ii) A new Canal Map prepared from transfers from the 3rd edition of India on the 32-mile scale; (iii) additions to the 128-mile engraved map of India; and (iv) additions to the engraved map of Western Himálayas, the map of the North-Western Provinces and Oudh, and the map of the Punjab.

402. The provincial maps of India on the 16-mile scale have all been revised. The map of Assam for lithography as well as engraving has received additions and corrections to railway lines, and has been published; the map of Bengal, Bihár, Orissa and Chota Nágpur has been similarly treated, whilst this map and the map of Gujarát have had the hills added in brush-shading for the engravers; and the maps of the provinces of the Punjab, Rájputána Agency, Central Provinces, Sind, and Upper Burma have been brought up to date with railway lines, roads, or boundaries.

403. Four divisional maps and eleven district maps have been under revision with reference to railway lines, the boundaries, and their principal roads; and nine new district maps have been completed and published.

404. Twenty seven standard maps of the various provinces on the 1-inch scale have been published during the year, and sixty-eight have been in progress. Of the former, fourteen sheets of the Central India Agency, the Central Provinces, or of the Rájputána Agency, were completed to margin ; and thirty-eight sheets of the same series were in different stages of progress. The remaining sheets were brought up to date with railway lines, or had the boundaries corrected from recent data supplied by the different Local Governments.

405. The maps in hand for the Administration Reports of the different Provincial Governments were forty-one. Thirty-six were completed and published, three were in progress, and two had the hills added in brush-shading for engraving.

406. As usual, the sheets of the Atlas of India have formed an important part of the current work performed by this section. Additions to railway lines, roads, canals, and changes to boundaries were carried out on fifty-eight sheets ; additions to names and details for engraving on forty-one sheets ; and five sheets were brush-shaded for engraving.

407. In addition to the preparation of the indexes for this report, the keeping up to date of the colouring of all the office copies of maps, and an increasing amount of correspondence, departmental and extra-departmental, have also formed a part of the current work of this section.

SECTION II.—REVENUE.

408. The ordinary routine work of this section consists in examining and preparing, for photo-zincography, the fair maps received from the field parties of the Revenue Branch; in bringing up to date and republishing the old maps ; in the preparation of the index maps for field parties and for the General Report ; in colouring maps on various scales ; in tracing maps, furnishing plans and supplying data to Government officials and others. The examination of the field books, traverse, and azimuth computations, etc., on which the several Revenue Surveys are based, is also done in this section.

Personnel.

Mr. G. D. Cusson, Officiating Head Draftsman, up to 17th October 1896.
" W. Stotesbury, Head Draftsman, from 18th October to 1st December 1896.
" J. McHatton, Head Draftsman, from 2nd December 1896 to 31st August 1897.
" T. Shaw, Officiating Head Draftsman, from 1st September 1897.

Extra Assistant Superintendents and Sub-Assistant Superintendents on duty.

Mr. G. Campbell, Extra Assistant Superintendent, 5th grade.
Mr. C. S. Littlewood, Sub-Assistant Superintendent, 3rd grade, from 30th June 1897.
" H. W. Biggie, Sub-Assistant Superintendent, 2nd grade, from 17th September 1897.

Native Draftsmen.

Munshi Abdul Aziz.
" Abdur Razak.
Babu Tincori Sen.
" Bacharam Banerjee.
" Ram Chunder Sen and 20 others.

Surveyors, etc., on duty.

Babu Rhedoy Chunder Das and 2 others.

409. The old 1 inch=1 mile maps of district Peshâwar (Punjab) have been revised as to their boundaries and interior details from the tracings of the 4-inch maps of the Settlement Survey, and have been drawn up in standard sheet form. The drawing of the maps is well advanced.

410. Four sheets in fourteen sections on the 2-inch scale of district Tavoy (Lower Burma) have been compiled from the 16-inch cadastral plans, and are being drawn for reduction to the scale of 1 inch = 1 mile.

411. Three sheets on the scale of 1 inch = 1 mile of North-Western Provinces have been completed to margin from the old 1-inch maps of district Gurgáon (Punjab) and Bhurtpur State for republication ; and two sheets of district Jalpáiguri (Bengal), in eight sections, on the scale of 2 inches = 1 mile were also redrawn for reduction to half scale, and corrected to date from the materials of the latest surveys.

412. A large number of sheets of Bengal and North-Western Provinces on the scale of 1 inch = 1 mile were corrected and additions made thereto from materials either furnished by the latest surveys or supplied by district officials. The old 1-inch maps of district Chhindwára and the ½-inch maps of district Saugor (Central Provinces) were also revised and corrected from tracings on

the 16-inch scale of maps received from the Settlement Officers with a view to issuing a revised edition.

413. Two large scale plans of the cities of Dhárwár and Hubli, of district Dhárwár (Bombay), were published on the scale of 8 inches = 1 mile; and a plan of Moulmein Cantonment has been redrawn on scale 200 feet = 1 inch for publication on full scale.

414. A map of Calcutta, embracing 16 miles of surrounding country on scale of 1 inch = 1 mile, was also prepared and published.

415. In addition to the above, a large amount of mapping has, as usual, been done for other departments; a plan of Bareilly City and environs, on scale 4 inches = 1 mile, showing the British position and military operations during the siege of 1857-58, has been prepared and published on the 2-inch scale for Mr. Forrest, Director of Government Records. A skeleton map of Siálkot (Punjab) on the ½-inch scale was also prepared for reduction to the ¼-inch scale for the Punjab Government, and also a district map of Hissar on the scale of 1 inch = 4 miles was republished for the Local Government on special requisition. A map of district Kámrúp (Assam) on the ½-inch scale, showing the village boundaries and country surveyed cadastrally up to 1892, has been completed for the Assam Government.

416. The series of special district maps on ½-inch scale prepared for the Government of the North-Western Provinces has now been completed.

417. The traverse computations of eleven field parties working in districts Tippera, Chittagong, Jalpáiguri, Balasore (Bengal), district Sibságar (Assam), districts Bhandára, Ráipur, Narsinghpur (Central Provinces), and districts Kyauksè, Akyab, Henzada (Burma), were examined. Traverse data, calculation of areas and such like information has, as usual, been prepared in this office and supplied to field parties and district officers. Of traverse data 654 pages were copied and supplied, and latitudes and longitudes of Revenue Survey points of districts Akyab, Jalpáiguri, Bhandára, Seoni and Bhurtpur State were calculated. A report on the character, scale, and date of survey of all the districts in the Lower Provinces, from the commencement of the Revenue Survey operations in 1830, was prepared for the Director of Land Records, Bengal. The areas by *parganas* of 18 standard sheets were calculated, as also of district Hoshiárpur, of Dhárwár City, and of the estates of the Mahárájá of Benares. The area and cost of all cadastral surveys in the North-Western Provinces for the years 1872 to 1896 were prepared. The areas of districts Balasore and Cuttack were adjusted according to revised boundaries. Twenty-nine tracings of sheets and thirty tracings of village plans were also made and supplied to district and other officers. One hundred and forty maps on various scales were coloured.

A large amount of correspondence has, as in former years, passed through this office, the number of letters dealt with being 1,317.

SECTION III.—CADASTRAL.

418. This section consisted of one Sub-Assistant Superintendent, one writer, six permanent draftsmen and six tracers who were employed in preparing the original maps of all cadastral surveys for photozincography and zincography. The maps to be examined are, on receipt of the originals, submitted to a cursory examination in order to see that the sheets are in every respect fit for reproduction.

419. In the North-Western Provinces the returns for the previous year showed 6,845 sheets of district Garhwál remaining to be published, and during the year 2,906 sheets of the same have been published, so the balance of 3,939 sheets remain to be printed during next season; of these 400 sheets have been prepared for publication.

420. In Burma the publication of the cadastral maps of the following districts have been in progress:—Meiktila, Minbu, and Sagaing in Upper Burma and Thatôn in Lower Burma. Of Upper Burma 1,597 sheets and of Lower Burma 609 sheets have been published; in addition to these 13 sheets of district Thatôn have been reprinted, and 642 original sheets have also been prepared for publication.

421. In Bengal 261 sheets of district Backergunge of Dakhin Sháhbázpur Estate. have been published at the request of the Board of Revenue, but the

remaining 11 sheets of skeleton plots (1 and 2 inches=1 mile) *are not to be printed.

In Assam 191 original sheets of district Cachar were received from the party during the past twelve months, and 120 sheets of the same have been published; the remaining 71 sheets have been prepared for publication; besides 3 sheets of district Darrang and 6 sheets of district Nowgong were published during the same period. Those remaining incomplete are districts Kámrúp (8 sheets), Sibságar (8 sheets) and Sylhet (45 sheets). These are mostly blocks and waste land, and under existing orders are not to be printed.

The total number of maps passed for publication during the year was 5,737, of which 5,493 were actually printed, 3,912 having been photozincographed and 1,581 zincographed. At the close of the year there were remaining to be published 5,285 sheets against 8,916 in last year, showing a decrease of 3,631 sheets.

SECTION IV.—BENGAL PROVINCIAL.

Personnel.

Mr. T. Shaw, In charge from 1st October 1896, to 31st August 1897.
" E. P. S. Hill, In charge from 1st September, 1897.
" A. B. Smart, Sub-Asst. Supdt., 1st grade.
Babu Sarat Chunder Sen " " 2nd grade from 1st to 31st October, 1896.

Permanent Establishment.

5 Draftsmen.

Temporary Establishment.

6 Computers and Writer etc.
4 Draftsmen.

422. The cadastral maps dealt with during the year under report were those of Bihár. For Bihár 9,195 cadastral maps were received, of which 7,523 were reduced by pentagraph to the 2-inch scale for the compilation of the standard sheets; the total number of sheets dealt with in Bihár reached 10,437, of which 2,914 were received during previous years. From Orissa 4,864 cadastral sheets were received, but their reduction to the 2-inch scale has not up to date been taken in hand. The same remark applies to 727 sheets of Chittagong district.

423. For Bihár 12 sheets have been outlined and completed, whilst the details of 8 more have been reduced. These are well in hand and a number of publications may be anticipated during the current year.

424. The preparation and final publication of the 2-inch standard sheets was chiefly confined to the Orissa series. The outlining of 34 standard sheets was completed; 56 had the interior details finally examined; 44 were forwarded to the Photographic Office for reduction; 60 proofs were examined and final press order for twelve 1-inch sheets was given. This last figure is low, but delay in publication has been unavoidable owing to the non-return of proofs sent to district authorities on account of boundary disputes, etc. The outlining of 10 sheets has yet to be dealt with; this will be taken in hand and completed at an early date. The publication of the remaining Orissa 2-inch sheets should be completed during the current year.

425. In letter No. 8531, dated 31st July 1893, the Government of Bengal requisitioned for a special publication on the 2-inch scale of 26 sections of the Orissa standard sheets containing irrigated areas, 21 sections were completed previously and 5 sections (in sheets 166 and 193) during the year under report.

* Mr. Spring reports that Mr. Pocock and Mr. Stotesbury in their posts as Chief and officiating Chief Draftsmen, also Mr. McHatton and Mr. Shaw as Head and officiating Head Draftsmen, respectively, supervised their establishments most efficiently. Messrs. Barker, Hill and Ewing have also done very well as heads of the Examining, Bengal Drawing and Cadastral Sections. Messrs. Campbell and Madras have also done good work. The European draftsmen have been well reported on, especially Messrs. Green, Musgrove and Sinclair, and of the Native Establishment, Babus Purna Chandra Sen, Sarat Chandra Chatterji, Narendra Nath Mukherji, Subodh Chandra Sarkar, amongst others, have rendered good service.

ENGRAVING OFFICE.

426. Mr. A. E. Spring has held charge of this office throughout the year. Mr. T. B. Rodger has been on furlough during the year, and Mr. A. R. Coard has taken 12 months' furlough from September 30th.

Personnel.

Mr. A. E. Spring, Assistant Surveyor-General, in charge.
Mr. J. Fulford, Head Engraver.
„ S. M. Coard, Engraver.
„ T. B. Rodger, „ on furlough.
„ A. W. N. James, „
„ A. R. Coard, „
„ E. Earle, „
„ E. C. V. Ollenbach, „
„ L. H. Musgrove, „
„ F. R. C. Scallan, „
„ A. T. Vieux, „
„ A. E. W. Cann, „
30 Native Engravers.
2 Apprentices.

Copper-plate Printing Section.

Mr. W. T. Collins, Copper-plate Printer.
„ A. E. Pilley, Assistant Copper-plate Printer and Store-keeper.

427. The outturn of work for the year in "Outline" and "Hills" is about the same as last year, but on account of the unusually large number of plates projected and borders partly divided, the outturn in "Writing" is less; still the general outturn is very good.

428. The sheets published during the year are six quarters of the Atlas of India, 14 district maps for administration reports, 16-mile map of Mysore and Coorg (with hills), index to the standard sheets of the Bombay Presidency, a new weather chart for Photo-Litho Office and two scale plates. Two brass plates have also been completed, one with an inscription of the standard bench-marks of Calcutta and the other for the Great Trigonometrical Office.

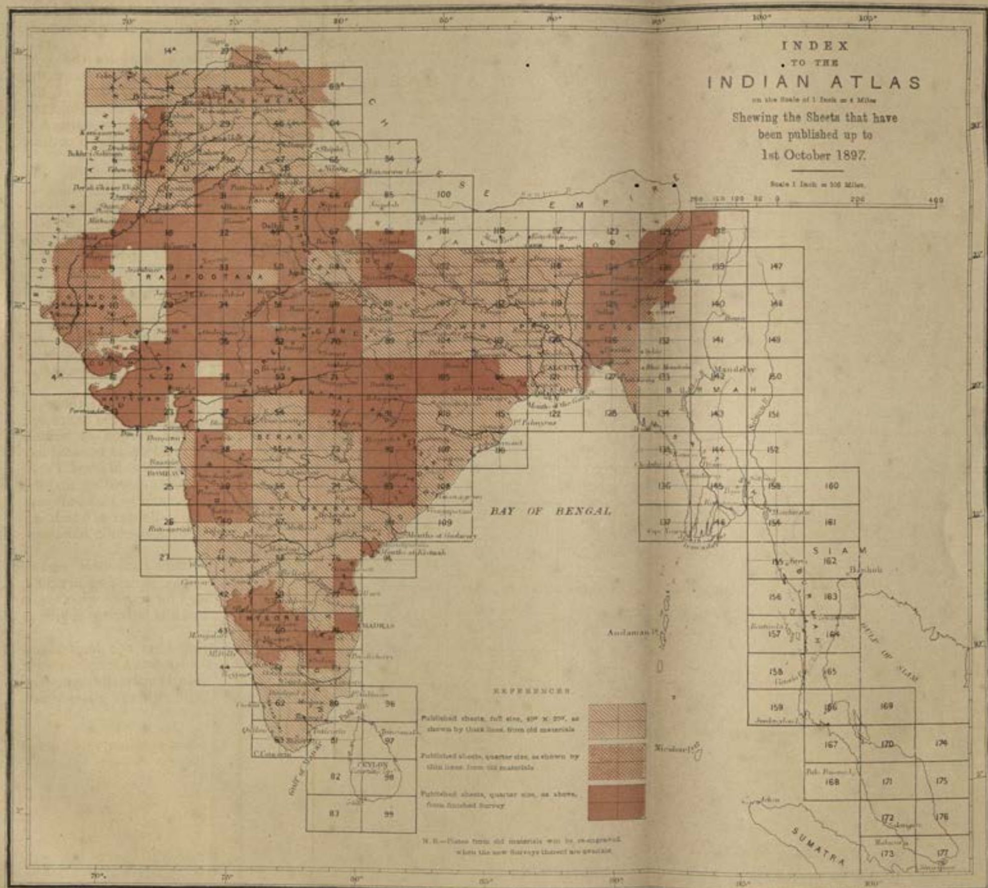
429. Fifty unpublished quarter Atlas Sheets in various degrees of progress have been in hand during the year, 93 published quarter sheets and 19 full sheets have been brought up to date as far as materials existed, and 35 Atlas sheets were projected. In all 349 plates were worked on, being 79 in excess of last year.

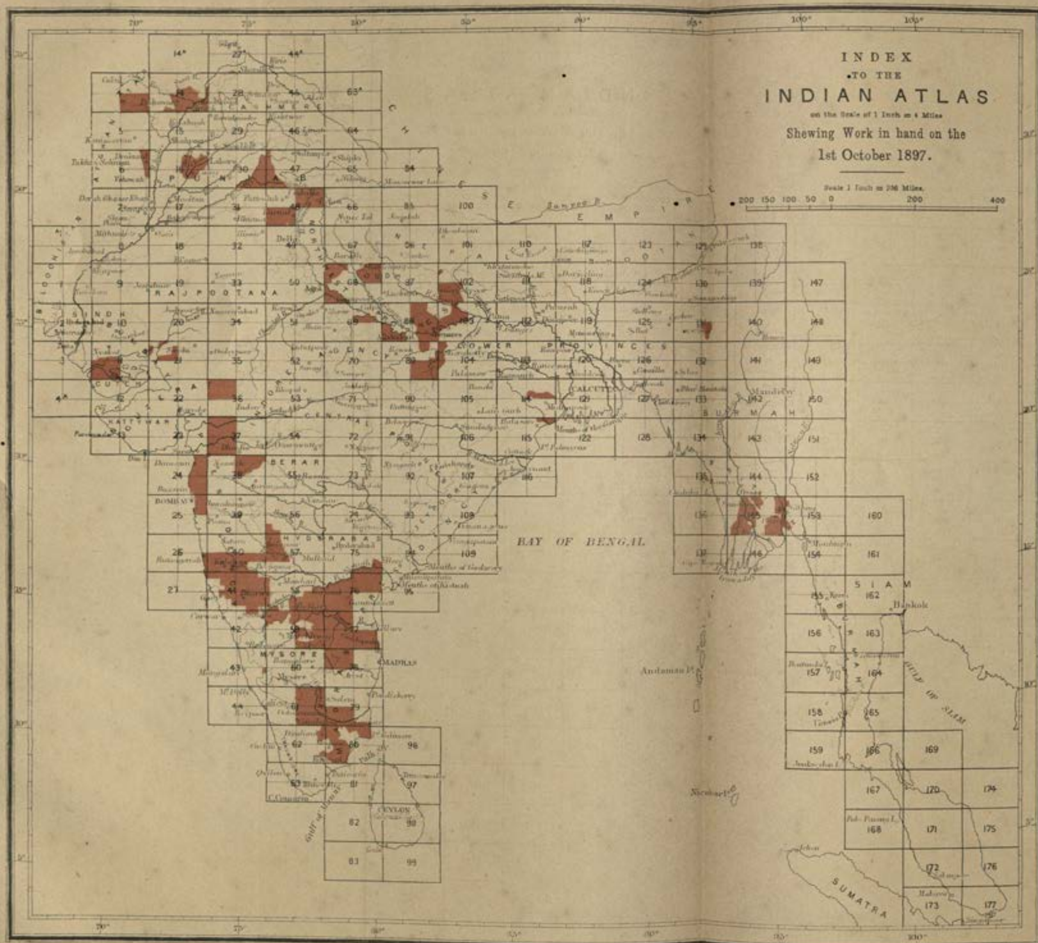
430. The 16-mile maps of provinces have been dealt with thus: those of Assam, Central India Agency and Mysore (without hills) have been corrected to date, the two new plates of Bengal have had a large portion of writing engraved, that of the Bombay Presidency has been filled up as material has been received, the hills on the Gujarát map are in progress, the Madras Presidency map in six sheets is well advanced, both in outline and writing, and the Punjab and Kashmír map in four sheets has been constantly in hand with corrections and additions, sheet 1 is completed with hills, and sheet 2, which is a very heavy sheet of hills, is in progress. Rájputána also has been in hand with corrections and additions.

In addition to the 14 published district maps, 23 others have been worked on, and some additional work for the new Calcutta Survey plates, 16″=1 mile, has also been commenced, a new plate of map headings for transfers has been completed, and 57 plates for Photo-Litho office have had the lettering engraved on them.

431. The Copper-plate Printing Section has printed 21,250 impressions during the year, which is slightly in excess of last year, but a larger outturn could have been done if the orders for scales from the Mathematical Instrument Office had not fallen off. The Steel Facing Section dealt with 221 plates which is also in excess of last year.*

* Mr. Spring reports that the Head Engraver, Mr. Fulford, has given great satisfaction in the discharge of his duties, and he reports well of all his assistants.


INDEX
TO THE
INDIAN ATLAS
Shewing the Sheets that have
been published up to
1st October 1897.
REFERENCES
BAY OF BENGAL
RAJPOOTANA
BERAR
MYSORE
MADRAS
CEYLON
BURMAH
Mandalay
SIAM
Andaman Is.
SUMATRA



Litho., S. I. O., Calcutta.

No. 407-S. 94.



Photo-etching

Survey of India Offices, Calcutta, February 1898.

THE SURVEY OF INDIA ECLIPSE PARTY

THE PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE.

432. This office remained in the charge of Colonel J. Waterhouse, S. C., until the 10th May 1897, on which date he proceeded on furlough for one month, preparatory to retiring from the Department on attaining Colonel's allowances on the 10th June. He was succeeded by Mr. T. A. Pope, who was confirmed in the post of Assistant Surveyor-General on the 10th June and held charge during the remainder of the year. Colonel Waterhouse's connection with this Office had extended over a period of thirty years, during which the processes employed in it were greatly improved and developed, and the outturn of all classes of work enormously increased. The loss of his valuable services and unique experience is greatly regretted.

The post of Head Assistant, Lithographic Branch, vacated in August 1896, on the retirement of Mr. H. L. Lepage, was permanently filled on the 31st March by Mr. R. Fogarty, who was selected in England for the post by the Secretary of State for India. On Mr. Fogarty's arrival, Mr. S. M. Coard, who had been officiating in the appointment, reverted to his permanent post in the Engraving Office. Mr. Fogarty has proved himself to be an intelligent and capable assistant, and well qualified to supervise the somewhat complicated work of the lithographic sections.

Personnel.

Colonel J. Waterhouse, S.C., Assistant Surveyor-General in charge up to 10th May 1897.
Mr. T. A. Pope, Assistant Surveyor-General in charge from 10th May 1897.

NORMAL ESTABLISHMENT.

LITHOGRAPHIC AND PRINTING DIVISION.

Mr. S. M. Coard, Officiating Head Assistant, up to 29th March 1897.
" R. Fogarty, Head Assistant, from 30th March 1897.
" E. Dowling, Head Draftsman, up to 9th March 1897.
" A. J. J. Rodrigues, Draftsman, from 15th March 1897.
Babu Ambica Churn Mookerjee, Draftsman.
Munshi Abdool Hamid, Examiner, up to 12th April 1897.
" Abdool Mujeed, Examiner, from 1st May 1897.
1 Apprentice, 28 draftsmen and 6 colorists.

Lithographic and Zinc Printing Section.

Mr. E. A. LeFranc, Head Printer.
" D. Deas, Chromo-litho-printer.
[illegible] S. U. Ravenscroft, Assistant Chromo-litho-printer.
[illegible] Andrews, Machine Printer.
[illegible]ntice, 2 machine printers, [illegible] litho and zinc printers, 9 machinemen, 17 spongemen, 40 pressmen, 1 paper-wetter, 2 stone grainers, 2 stone polishers, 4 zinc grainers, 1 ink-grinder, 1 engine-driver and 1 fireman.

Type Printing Section.

Mr. E. De Pyvah, Head Printer, 12 compositors, 3 type printers, 3 inkmen, 3 mates, 2 machine type printers, 2 machine inkmen, 1 impositor, 1 roller-moulder and 1 boy.

PHOTOGRAPHIC AND GENERAL DIVISION.

Mr. J. Harrold. Photographer.
" C. J. Meade, Assistant Photographer.
" F. N. Murphy, do.
Munshi Ismail Khan, do., up to 9th November 1896.
Mr. N. J. Gonsalves, Assistant Photographer, from 1st April 1897.
Munshi Habibul Hossain, Assistant Photographer.
5 Assistant Photographers and 8 labourers.

Heliogravure Section.

Mr. A. W. Turner, Photo-engraver.
" J. T. Meade, Assistant Photo-Engraver, up to 31st March 1897.
1 Assistant Photo-Engraver, 1 engraver, 1 Assistant Engraver, 4 copper-plate-printers, 6 pressmen, and 11 plate polishers.

Correspondence, Stores and Accounts Section.

Babu Kanny Lall Sen, Storekeeper.
Mr. A. B. Carville, Head Clerk, from 5th April 1897.
Babu Kedar Nath Ghose, Clerk.
" Gopal Chundra Mookerjee, Clerk.
" Surji Coomar Banerjee.
" Rajani Kanta Chatterjee.
4 Clerks, and 1 paper-keeper.

CADASTRAL ESTABLISHMENT.

Photographic Section.

Mr. H. Haward, Head Photo-Assistant.
" R. George, Photographer.
" L. Lagnier, Photographer.
" T. Lloyd, Photographer.
" J. Vieux, Assistant Photographer.
7 Assistant Photographers, and 10 labourers.

Zinc Printing Section.

Mr. F. R. Vandyke, Zincographer.
" J. B. Mackenzie, Zincographer.
" P. Michael, Assistant Zincographer.
Babu Khetter Mohun Das, Clerk.
1 Clerk, 9 Zinc correctors, 9 zinc printers, 10 spongemen, 17 pressmen, and 11 zinc grainers.

Mr. E. Dowling, Head Draftsman, having obtained employment in the Public Works Department, vacated his post on the 10th March 1897, and Mr. A. J. J. Rodrigues was appointed in his place on probation. Babu Kanny Lall Sen, Head Clerk, was promoted to the vacant post of Storekeeper with effect from the 15th April 1896, and Mr. A. B. Carville was appointed Head Clerk on probation on the 5th April 1897. Munshi Abdul Hamid, Draftsman, retired on the 13th April 1897, after thirty-two years' approved service in the Lithographic Drawing Section, and his loss is much regretted. Mr. J. T. Meade, Assistant

Photo-engraver, was dismissed from the 6th July 1897, for refusing to obey orders to return to duty from furlough.

433. An abstract of the work performed in all sections of the Office during the year is given in the following table:—

General Abstract of Work done during the year 1896-97.

Classification.	Sheets or Subjects.	Negatives and transparencies.*	Photo-Zincographic and Lithographic Printing.								Type Printing.			Silver and other Printing.		Heliogravure and Electrotyping.				Value.
			Photo-transfer Prints.	Zinc Plates transferred.	Zinc Plates printed.	Stones.	Pulls.	Number of Copies.			Pages or items.	Pulls.	Copies.	Silver Prints.	Blue Prints.	Heliogravure Plates.	Heliogravure Prints.	Photo-Blocks.	Electrotypes.	
								Coloured.	Uncoloured.	Total.										R a. p.
Departmental Maps, etc.	1,019	1,375	1,401	509	509	76	133,323	28,299	163,778	130,077	10,054	931,543	529,601	137	2,699	13	3,919	...	13	60,696 0 9
Cadastral Maps . .	5,634	4,056	3,971	5,645	5,615	...	133,223	...	122,293	122,293	...	...	...	...	...	...	...	...	...	69,267 15 6
Extra-Departmental Maps and Plans, etc. . .	1,197	841	632	284	596	468	587,399	117,775	482,927	600,702	...	...	...	217	568	118	68,327	...	...	83,551 14 6
Total . .	7,880	6,272	5,794	6,438	6,719	544	853,945	144,074	708,993	853,067	10,054	931,543	529,601	351	3,267	131	72,246	...	13	213,517 14 9
Total of 1895-96 . .	7,020	5,956	5,860	5,782	6,061	529	862,623	121,781	826,276	948,057	11,916	1,271,557	668,795	527	2,542	144	56,388	5	17	219,778 15 6
Differences. . .	+ 860	+ 316	− 66	+ 656	+ 658	+ 15	− 8,678	+ 22,293	− 117,278	− 94,985	− 1,862	− 340,014	− 139,131	− 176	+ 725	− 13	+ 15,858	− 5	− 4	− 6,261 0 9

434. As regards outturn, the year may be said to be a good average one. The number of original subjects dealt with (which gives a fairly accurate idea of the amount of work performed) was 7,880 or 860 in excess of 1895-96, and more than in any previous year. The number of negatives taken, and the amount of lithographic drawing on transfer paper or stone, are consequently proportionately larger than usual, though the latter class of work cannot be accurately recorded and is not shown in the above table. The outturn of the zinco. and litho. machines and presses was practically the same as last year, amounting to 853,945 pulls, as against 862,623, the deficiency representing the work of about a day and a half, which may be accounted for by the extra holidays given for the Jubilee. The outturn under this head depends largely upon whether the number of copies printed from each subject averages high or low. In the latter case, time that would otherwise be occupied in printing is lost in the more frequent changes of stone or plate required, and the outturn of work done, as represented by the number of pulls and copies made, is apparently less, though it is not actually so. During recent years, and particularly during the year under report, the average number of copies printed from each subject has been low, and a great deal of colour work has been done, necessitating more frequent changes and a smaller outturn of printed copies in proportion to the number of original subjects reproduced. The number of pulls from the machines and presses should not be taken as an index to the year's outturn of work, which may usually be much more fairly gauged by the number of original subjects taken in hand and completed. There has been a large increase in the number of departmental maps, etc., printed off, and also of cadastral sheets, but a decrease in the number of maps and plans reproduced for other departments. In the Type-printing Section there is a trifling decrease in the number of pages or items set up, and a more considerable decrease in the number of pulls and copies, the demand for departmental forms having been smaller than usual, owing to the requirements of the Department having been well supplied in advance by the large outturn under this head last year. In the Heliogravure Section, 72,246 prints were made from 131 copperplates etched by the photogravure process, an increase of 15,858 prints over the number made last year, though the number of plates etched was thirteen less. The number of hand-engraved copperplates electrotyped was thirteen, or four less than last year. In the Silver-printing Section the outturn of cyanotype prints, which form the chief work of the section, was considerably larger, though somewhat less silver-printing was done.

435. Under the head of departmental work, the following may be mentioned as comprising the most important maps dealt with during the year:—

Of general maps, the canal map of India, in six sheets, on the 32-mile scale, was completed and printed from stone in three colours. Further additions have been made to sheets Nos. 1, 2 and 4 of the third edition of the 32-mile map of India, and it is impossible yet to assign any probable date of completion of this map. The 24-mile map of Afghanistan, with hills in grey, was re-printed during the year and 1,400 copies supplied to the Map Record and Issue Office. The new chromo-lithographed map of Afghanistan on the same scale was held in abeyance pending the receipt of further additions and corrections, but these were received and put in hand immediately after the close of the year.

Of provincial maps, re-issues with additions and corrections were made of the following:— Assam, on the 16-mile scale; Punjab and surrounding countries (skeleton), on the 32-mile scale; Punjab, on the 80-mile scale; North-Western Provinces and Oudh, on the 32-mile scale; and Central Provinces, on the 32-mile scale. A map of the North-Western Provinces and Oudh, showing districts and states, was published on the 16-mile scale.

The divisional maps of Chota Nagpur and Patna, on the 8-mile scale, were re-published with additions and corrections.

New issues of the following district maps, on the 4-mile scale, compiled from the engraved atlas sheets, were made:—Bankura, Khasia and Jaintiah Hills, and Manbhum. The following were re-published:—Champaran, Twenty-four Parganas, Dacca, Gaya, Lakhimpur, Saran, Hoshangabad, Murshidabad, Bhamo and Myitkyina, and Pabna. Two-inch scale maps of Garhwal and Naini Tal, specially prepared for the North-Western Provinces and Oudh Government, were also published.

Five hundred and fifty-one sheets of standard maps of the Topographical and Revenue Surveys, on the scales of 4 inches, 2 inches, 1 inch, ½ inch and ¼ inch to the mile, have been taken in hand during the year for re-printing and for publication. One hundred and eighteen plates and one stone were printed off, including 90 sheets on the 1-inch scale, comprising 6 of Bengal, 10 of Bombay, 12 of Lower Burma, 3 of Upper Burma, 14 of Central India and Rajputana, 1 of the Central Provinces, 40 of the Indus riverain survey, 1 of Madras, 2 of the North-Western Provinces and Oudh, and one of the Punjab. Three sheets of Lower Burma, on the 4-inch scale, were also printed off. Of the transfrontier surveys, 3 sheets, including one colour plate, of the North-East Frontier, and 3 sheets, including one colour plate, of the South-East Frontier, on the 4-mile scale, besides 5 sheets on the 8-mile scale of the two latter surveys, were printed off.

The plans of cities and cantonments printed off during the year include a map, on the 8-mile scale, of Dharwar city and environs, in two sheets; a 12-inch map of the city and environs of Ajmere; a 6-inch map of Calcutta, and new editions of the 1-inch map of Calcutta and surrounding country, with table of distances, and of the 3-inch skeleton map of Simla and Jutogh. Ten sheets of the new Moulmein town survey, on the scale of 50 feet to the inch, were reproduced, but not printed; also an 8-inch map of Hubli city and environs, a 12-inch map of Cawnpore cantonment and environs, a 6-inch map of Lucknow Cantonment, and a 6-inch map of the cantonment and environs of Jullunder.

Among the miscellaneous departmental publications may be mentioned a route map for the Western Himalayas, Kashmir, Punjab and North India, with portions of Afghanistan and Baluchistan, etc., on the 32-mile scale, re-published with additions to railways; six sheets of the Burma-Siam boundary, on the 1-inch scale; a map of a portion of Tibet surveyed by Captain Deasy, on the 8-mile scale, and several sheets of the Madras forest survey on the 4-inch scale.

436. As already stated, the amount of work done for other departments shows a decrease during the year under report. The number of subjects completed and taken in hand was 1,197, as against 1,470 last year, and the total number of complete copies was 600,702, against 631,133 last year, and their value R83,555, against R86,364.

The plates for Part III of Mr. Smith's report on Fatehpur Sikri have now been completed; 46 plates were photo-zincographed and 18 plates photolithographed, and 650 copies of each printed off. The plates for Part IV were taken in hand. For the Archæological Survey, Madras, 62 inscriptions pertaining

to the monumental remains of the Dutch East India Company were photo-zincographed, but not printed off. For the Board of Revenue, North-Western Provinces and Oudh, a district map of Garhwal, on the ¼-inch scale, was printed and 200 copies were supplied. For the Geological Survey Department a map of India showing distribution of corundum was lithographed, but not printed off. Three silver-prints of each of 22 plates of buildings damaged by the earthquake were made for the same department. For the Director of Land Records and Agriculture, Bengal, nine chalk drawings and four stamped patterns on cloth, illustrating a monograph on cotton fabrics, were taken in hand for lithography and 500 copies of the patterns were printed off. For the Director of Land Records and Agriculture, Burma, 40 sheets of the Moulmein town survey were photo-zincographed. For the Government of India, Revenue and Agricultural Department, 20 maps to illustrate a list of archæological remains in the Central Provinces and Berar were lithographed and 8,200 copies printed. For the Public Works Department, Government of India, a railway map of India, on the 80-mile scale, was re-printed with corrections and 900 copies supplied; 650 copies of the same map were printed for distribution to military officers under instructions from the Quarter Master General in India. Another map of India, on the 64-mile scale, in two sheets, showing railways with stations, was photo-zincographed and 4,700 copies printed for distribution. Fourteen plans and 10 diagrams, showing the method of constructing buildings less liable to damage by earthquake, were lithographed for the Calcutta Building Commission. For the Reporter on Economic Products, three drawings of Rhea plants were chromo-lithographed, and four sketches and diagrams pertaining to magnesite areas were re-printed from stone. For the Meteorological Department a large amount of work was again done, including 63 maps and charts re-printed from stone, and 205,291 copies supplied. Several maps of the country ten miles round cantonments were again prepared or re-printed during the year for the military authorities, *viz.*, Amritsar, Dinapur, Ferozepur, Jhansi, Jullunder, Indore, Lansdowne, Manipur, Multan, Nowgong, Peshawar, Meerut, Meean Mir, and Sialkot. Six diagrams showing the method of filling shells with high explosives were lithographed, and 156 copies printed for the Military Department of the Government of India. For Dr. M. A. Stein, P.H.D., a map of ancient Kashmir, and one of ancient Srinagar, reproduced from the survey of 1859-60, and showing ancient sites and names, were lithographed and 650 copies printed in two colours.

437. In the Heliogravure Section the work done was as usual all extra-departmental. Forty-seven views were photo-etched to illustrate the report of the Pamir Boundary Commission for the Foreign Department, and 6,250 copies were printed. Fourteen plates were photo-etched for the Technical Art Series, from which 11,600 copies were printed. A set of 32 ancient manuscripts from Central Asia was reproduced by the same process on 21 plates, with the sanction of the Government of India, for the Asiatic Society of Bengal, and 800 copies of each printed. As 50 copies of each were urgently required for despatch to the Oriental Congress which assembled in Paris in September 1897, it was necessary to complete the whole work, including taking the negatives and transparencies, etching and lettering the 21 plates, and printing 50 copies of each, in the space of one month, which was successfully performed, though it strained the powers of the section to the utmost. Most of the manuscripts were exceedingly difficult to reproduce, being much discoloured by age, which rendered it necessary to clean them carefully in order to obtain favourable results. Six plates were photo-etched, and 500 copies of each printed, to illustrate a report by Dr. Führer on Buddha's birthplace in the Nipal Tarai. Twenty plates were prepared for Part III of the Moghal Architecture of Fatehpur Sikri, for the Archæological Survey of the North-Western Provinces and Oudh. Twelve plates of Crustacea and Mollusca, to illustrate the zoology of the R.I.M.S. *Investigator*, were etched, and 250 copies of eleven of them were printed. For the Indian Museum Notes 8 plates were etched and 4,310 copies printed. Two plates of a copper-plate grant of Ratnapala, and three of a similar grant of Bala Varman, were etched for the Asiatic Society of Bengal, but not printed. Specimens of recent work executed by the photo-etching process will be found in the frontispiece, which is an enlargement from one of the negatives of the recent total eclipse of the sun taken by the Survey of

India eclipse detachment at Dumraon in January last, and in the illustration at page 87, which represents the eclipse party at work. The view of the Manshai Bridge, Cooch Behar State Railway, showing the effects of the earthquake of the 12th June last, which will be found at page i of the Appendix, is another specimen of the same process.

438. Successful trials were made during the year of the "Enameline" half-tone and line block process, which established its utility for the preparation of type blocks, as well as in the reproduction of miscellaneous subjects in which a high degree of finish is not essential. Though undoubtedly less convenient in many respects than the photogravure process, it has the great advantage that the blocks can be printed in the type machine, at the rate of several hundred copies per day. Since the close of the year under report the process has been employed with excellent results, which amply repay the time spent in working it out. Full details of the process are given in Mr. Pope's report in the Appendix. At page xxviii of the Appendix is given a specimen of enameline work. It is a view of the ruins of the Commissioner's Cutcherry at Gauhati, and is one of a series of views reproduced to illustrate Mr. R. D. Oldham's report on the earthquake. The smaller illustration on page xxx is a reduction from a pen-and-ink drawing of a ceiling panel at Fatehpur Sikri, printed from an enameline block set up with the type. It is a fair specimen of the application of the process to line subjects.

439. During the year, a scheme for the reorganisation of the office, abolishing progressive salaries, and placing the entire establishment, together with the photo-zinco and type-printing staff of the Trigonometrical Branch Office at Dehra, in one list for the purposes of promotion, was worked out by Mr. Pope and submitted to the Surveyor-General. It is hoped that it will receive the sanction of the Government and come into force early in the ensuing year.*

MAP RECORD AND ISSUE OFFICE.

440. During the year under review the charge of this office continued to be held by Mr. T. A. Pope up to the 31st March 1897, when he was relieved thereof by Mr. A. E. Spring.

Personnel.

Mr. T. A. Pope, Deputy Superintendent, 1st grade, in charge up to 31st March 1897.
" A. E. Spring, Deputy Superintendent, 2nd grade, in charge from 1st April 1897.
" F. A. D'Rozario, Head Clerk.
" H. R. Vallis, Map-Curator and 17 other clerks.

441. The number and value of maps issued during the year are as follows:—

Maps issued.	Number.	Value.
General maps to Government officials	96,306	68,658
Ditto to Private individuals	10,853	11,772
Ditto to India Office, London	3,746	5,226
Ditto to Agents	1,503	2,290
TOTAL . .	1,12,408	87,946
Cadastral maps to Government officials	94,922	69,981
GRAND TOTAL . .	2,07,330	1,57,927

*Mr. Pope reports well of the work done by all his principal assistants, *viz.*, Messrs. Fogarty, LeFranc, Vandyke, Deas, Mackenzie, and DePyvah, in the Litho., Zinc and Type-printing Sections, and Messrs. Haward, Turner, Harrold, George, Lagnier and Lloyd, in the Photographic Sections, all of whom have worked to his entire satisfaction. Among the junior assistants, the following are specially mentioned :—Messrs. Ravenscroft, Michael, Andrews, Murphy, Vieux, Gonsalves, DeSilva and Francis.

Of the native assistants, Babus A. C. Mookerjee and Dino Nath Dass, and Munshis Abdul Mujid, Mahomed Yasin, Enayetullah and Hyder Ali, draftsmen; Habibul Hussein, Abdul Rahman, A. C. Bhattacharjee, Preonath, Abdul Wadood, and Abdul Ali, assistant photographers, are commended. Babu Kanny Lall Sen, head clerk and accountant, has continued to give entire satisfaction, and Babus Kedar Nath Ghose, G. C. Mukerjee, S. K. Banerjee, R. K. Chatterjee and N. N. Mukerjee, clerks, are also deserving of mention.

There has been a considerable increase in the number and value of maps issued during the year when compared with last year's total :—last year they were 2,00,416 and R1,06,702, whereas this year they rose to 2,07,330 and R1,57,927 ; shewing an increase of 6,914 in number and R51,225 in value.

The amount realized from cash sales was R24,659 ; *viz.* :—R11,772 from private individuals, R1,740 from agents and R11,147 from Government officials ; shewing an increase of R1,152 over the cash receipts of the year preceding.

In the Revenue Section 651 applications were received from private individuals for extracts from original records of the Revenue Surveys, and 2,838 for certified copies of village plans, tracings and traverses, which realized a sum of R8,695.

The details of work are given in the following statement and show a small decrease below last year's figures :—

Details.	Number.
Applications received for maps	4,152
Letters issued in reply	3,110
Cash and credit map sale bills	1,764
Invoices and receipts issued for published maps	2,877
Ditto ditto cadastral maps	186
Ditto ditto extracts from original records	318
Packets, parcels and local despatches	5,315
Ditto ditto received in office	630
Packages despatched by rail and steamer	344
Ditto received ditto ditto	52
Maps coloured for sale and issue	26,865
Ditto for other departments	2,055

A list of the maps and charts published during the year, copies of which have been stored in this office, will be found at page 99.*

MATHEMATICAL INSTRUMENT OFFICE.

Personnel.

Colonel M. W. Rogers, R.E., Assistant Surveyor-General, in charge from 1st April 1896 to the 3rd February 1897.
Lieutenant-Colonel J. R. Hobday, I.S.C., in charge from the 4th February 1897 to 31st March 1897.

Workshop Branch.

Mr. T. Bolton, Mathematical Instrument Maker
Mr. T. R. Theakston, Assistant ditto.

Store Branch.

Mr. M. C. Belletty, Instrument Store Keeper.
Babu Womesh Chunder Chowdhry, Material Store Keeper.

Office Establishment.

Mr. W. Campagnac, Head Clerk.
„ W. R. Tulloch, 2nd Clerk.
Six clerks and three temporary clerks.

442. The charge of the office was held by Colonel M. W. Rogers, R.E., from the beginning of the financial year until the 3rd February 1897 when he retired from the service and was relieved by Lieutenant-Colonel J. R. Hobday, I.S.C.

443. All the figures in this report refer to the financial year, *i.e.*, from 1st April 1896 to 31st March 1897. During this period the number of serviceable instruments received into store was 61,558 and their value was R2,59,405, whilst the number of those issued from store was 50,727 valued at R2,68,704. In the subjoined statement these figures are compared with those of the preceding year. There has been a decrease both in number and value of instruments received and issued, owing to the demand for instruments from railways and other large works being less this year than the previous one.

	1895-96.	1896-97.	Increase.	Decrease.
Number of instruments received	89,022	61,558	...	27,464
Value of ditto	288,055	259,405	...	28,650
Number of instruments issued	96,673	50,727	...	45,946
Value of ditto	354,890	268,704	...	86,186

* Mr. Spring reports that Mr. D'Rozario has continued to perform his duties, which are somewhat arduous and varied, to his entire satisfaction. Mr. H. R. Vallis, Map Curator, has as usual rendered excellent service, and Messrs. J. A. Vallis, S. A. Hazra and the other assistants have also worked satisfactorily.

From this table it will be seen that the number of serviceable instruments in store has increased by 10,831 and their value by R18,482.

444. In the following statement are shown the principal sources from which the serviceable instruments were received :—

SOURCES OF RECEIPT.	Number.	Value.
		R
From England on indent	16,046	92,368
By purchase in the local market	12,117	31,674
Manufactured in the workshop	7,045	22,908
Returned to store by public officers	8,865	15,055
From repairable stock after repair	17,474	97,277
From other sources	11	123
TOTAL .	61,558	2,59,405

The number of the instruments received from England on indent has increased by about 5,000 while their value has decreased by about R11,000. This is mainly due to the fact that no indents for the large expensive instruments such as levels and theodolites have been made for three years, all such instruments having been supplied from the repairable stock, which is being put into serviceable order by the establishments sanctioned for their repair. The value of instruments purchased in India has decreased by about R9,600. The number and value of instruments issued has decreased by 45,946 in number and R86,186 in value. The instruments manufactured in the workshop have also been reduced this year. Their class and value will be found in Table C in the Appendix. This is owing to the demands on this office from various departments being less this year than the previous one.

445. The number of instruments taken from the repairable stock and rendered serviceable by the workshop is larger in number than last year, and their value when repaired is in excess of that of the last three years. During the year under report the office has received into store 20,857 repairable instruments valued at R82,453, compared with 11,547 valued at R77,323 in the previous year. The total number of instruments from the repairable stock which were rendered serviceable was 17,474 and their original value was R64,162. These were repaired in the workshop at a cost of R33,116 and transferred at the enhanced value to the serviceable stock. The repairable stock has thus been increased by 3,383 valued at R18,291. This result is due to large returns of instruments into store by public officers, the number being so large as to defy the best efforts of the workshop to reduce the stock of repairable instruments, although as shown above the number and value of the instruments rendered serviceable has considerably increased this year, but it is expected that when the new extra establishment for repairing theodolites has been in full operation for a longer period, the value of the repairable stock on hand will begin to steadily decrease.

446. The conversion of old pattern levels and theodolites, alluded to in paragraph 553 of last year's report, has been steadily continued, and during the year under report 65 levels of obsolete patterns have been converted into serviceable instruments and issued.

447. During the year the number of indents complied with was 1,313 being exactly the same as last year. They were of the usual description and were submitted from all parts of India.

448. The cash payments for charges under R50 amounted to R31,128, being less than the previous year.

449. The gradual increase of repairable instruments has been represented in all the reports for many years, and in 1887 the Government of India sanctioned

an extra establishment costing R150 per mensem to help the office; which establishment was made permanent in 1890; and again in 1889 a further grant of R120 per mensem was sanctioned which was to be employed in converting levels of obsolete patterns into serviceable instruments, and again in 1895 a further grant of R220 per mensem was sanctioned to further increase the establishment for converting levels. Since the commencement of these grants 336 levels and 53 theodolites have been converted and issued, and all indents for such instruments on England have been discontinued.

450. The value of the English indents for the last five years is shown in the following table, which gives some indication of the saving which is being effected by the utilisation of the extra grant for repairing instruments—

Year.	Value of English Indent.
	£
1893-94	13,875
1894-95	12,981
1895-96	5,208
1896-97	5,079
1897-98	3,995

451. Table A (in the Appendix) shows the amount of debits against various offices and departments for instruments supplied and for work done. It also exhibits the credits for all instruments and materials returned to store. The value of the issues and repairs executed on book debit was R2,47,980, being R81,873 less than last year. This amount includes the value of instruments purchased with the extra departmental grant of R25,000, out of which R24,933 was expended. The credits for instruments returned into store amounted to R97,731, which is a decrease on the previous year. The grand total of the value of supplies including the cash sales is R2,79,108, or about a lakh of rupees less than last year.

452. The number of principal instruments repaired in the workshop is 4,227 or about 400 more than last year. The total number of instruments of all kinds repaired amounts to 5,284, or about 500 in excess of last year.

453. The profit and loss account of the workshop will be found in the Appendix, the result of the operations showing a nominal profit of R29, from which it appears that the rates for work are fairly correct.

454. Considerable labour has devolved on this office due to the mobilisation of the armies in the field on the North-West frontier, but no delay has arisen, and all indents have been promptly complied with.*

* Lieutenant-Colonel Hobday, I.S.C., reports that Mr. Bolton has conducted the general management of the Mathematical Instrument Office with commendable zeal and ability, and his services are deserving of every praise. Mr. Theakston, his Assistant, is an intelligent, hardworking and efficient officer. He officiated for Mr. Bolton during that officer's temporary absence on privilege leave for three months to his entire satisfaction.

In the correspondence and store branch, Messrs. Campagnac, Belletty and Tulloch have performed their duties efficiently, and among the native assistants the following are deserving of special mention: Babu Durga Churn Ghose, Gossain Das Roy, Shib Chunder Ghose and Narain Chunder Banerjee, clerks, and Womesh Chunder Chowdhry, material storekeeper.

II.—TRIGONOMETRICAL BRANCH OFFICE, DEHRA DÚN.

455. Lieutenant-Colonel St. G. C. Gore, R.E., Superintendent, Trigonometrical Surveys, was in charge of the office from the beginning of the year till the 20th September 1897, when he proceeded on privilege leave. During his absence Captain G. P. Lenox-Conyngham, R.E., carried on the Superintendent's duties. Mr. J. Eccles, M. A., went on furlough on the 17th March 1897, and Captain Lenox-Conyngham held charge of the technical offices up to the 20th September, when he made them over to Mr. H. W. Peychers. Lieutenant H. H. Turner, R.E., on his appointment to the department, was posted to this office on the 22nd April 1897 and transferred to No. 24 Party on the 1st August 1897.

Personnel.

Superintendence.

Lieut.-Colonel St. G. C. Gore, R.E., Superintendent, Trigonometrical Surveys.
Mr. J. Eccles, M.A., Deputy Superintendent, 1st grade, in charge Computing Office up to 16th March 1897.
Captain G. P. Lenox-Conyngham, R.E., Deputy Superintendent, 1st grade, in charge Computing Office from 17th March to 19th September, and in charge of Trigonometrical Branch Office from 20th September 1897.
Mr. H. W. Peychers, Extra Assistant Superintendent, 1st grade, in charge Computing Office from 20th September 1897.

(1) Computing Section.

Lieut. H. H. Turner, R.E., Assistant Superintendent, 2nd grade, from 22nd April to 1st August 1897.
Mr. H. W. Peychers, Extra Assistant Superintendent, 1st grade.
" A. D. L. Christie, " " " 2nd grade.
Babu Amba Prasad and 8 other Computers, 2 Copyists and 2 Writers.

(2) Printing Section.

9 Compositors and 2 Distributors.

(3) Photo-Zincographic Section.

Mr. J. S. Manuel, Zincographer, on sick leave.
" G. A. LeFranc, Officiating Zincographer.
1 Photographer, 6 Plate correctors, 5 Retouchers, 4 Zincprinters, 12 Assistant Zinc-printers, 1 Accountant, 1 Storekeeper, and 1 Despatcher.

(4) Correspondence Section.

Mr. J. Burbridge, Head Clerk, and 3 clerks.

(5) Stores, Workshops and Observatories Sections.

1 Writer, 1 Head-artificer and 3 Artificers.

(6) Drawing Section.

Mr. C. H. McA'Fee, Extra Assistant Superintendent, 3rd grade.
" J. A. Higgs, " " " 6th grade, from 4th March 1897.
4 Draftsmen, 1 Surveyor, 3 Assistants and 8 Apprentice Draftsmen.

(7) Solar Photographic Section.

Mr. C. F. Guthrie, Assistant Solar Photographer, up to 1st July 1897.
" R. W. Foster, " " " from 2nd July 1897.

(8) Training School.

Khan Bahadur Abdul Guffar, Surveyor, up to 30th June 1897.
Muhammad Zakaria, Surveyor, from 1st July 1897.

Mr. A. E. Wackrill, A.M.I.C.E., Superintendent of Trigonometrical Surveys, Ceylon, joined this office on the 27th September 1897, in order to become acquainted with the methods of observing and computing, as well as with all details in connection with field and office work obtaining in the Survey of India Department.

The office is divided into the following sections :—

(1) Computing.	(5) Stores, Workshops, and Observatories.
(2) Printing.	(6) Drawing.
(3) Photo-Zincographic.	(7) Solar Photographic.
(4) Correspondence.	(8) Training School.

(1) Computing Section.

456. Five instalments of field records were received during the year and stored as usual. In all sixteen requisitions for data and twenty-two indents for forms were complied with. The heights of the Indus Delta triangulation were re-computed, finally adjusted and entered in the pages of the co-ordinate list, this completes the work. A revision of the heights of the principal and secondary stations of the Great Arc Series, Section 18° to 24°, Bider and Jubbulpore series, was necessitated owing to sensible discrepancies being disclosed by the extension of the lines of spirit-levelling. A considerable amount of help was afforded in finishing off the reduction of Electro-Telegraphic Longitude observations for

1894-95. The preparation of press copy and examination of press proofs were carried on as hitherto; the outturn of these is given under the next section A considerable amount of work was involved in the reduction of the observation taken by Captain Deasy in his explorations in Tibet. Nine triangulation charts of the Punjab and Central Provinces surveys, and one of spirit-levelled heights, besides one other, were compared and examined. The meteorological observations were continued as usual.

(2) Printing Section.

457. The following is the progress made:—

(*a*) Pamphlet of spirit-levelled heights No. 7 C. P. (revised edition), completed.
(*b*) Hand-Book of Professional Instructions for the Topographical Branch (second edition), published.
(*c*) Tidal volume, 52 pages printed.
(*d*) Synoptical volumes of the Great Arc Meridional series, Section 8° to 18° and Indus Delta triangulation, 66 pages printed.

In addition to the above, a large amount of work was done in printing the letter-press for charts, headings and foot-notes for maps, and 25,000 copies of professional and other forms were printed.

(3) Photo-Zincographic Section.

458. The Zincographer being absent the whole year through ill health, the extra work of the section devolved on the Assistant Zincographer.

A great deal of extra work was thrown on this section during the last two months of the year on account of the demand for maps for the frontier expeditions, 8,846 pulls were made in twelve days. The usual routine of map publication was carried on and no arrears remain.

(4) Correspondence Section.

459. This has been conducted as usual.

(5) Stores, Workshops and Observatories Section.

460. Equipments for the survey detachments to accompany the Tochi, Malakand and Mohmand Field Forces and the Tirah Expeditionary Force were packed and despatched. The work in the observatories was done as usual.

(6) Drawing Section.

461. The map of portion of Tibet, on scale 1 inch = 8 miles, surveyed by Captain Deasy was completed, and the new maps of Dehra Dún Municipality, Simla Revisionary Survey and Mussooree and Landour were published. As the mapping of No. 18 Party was very much in arrears, assistance was rendered by this section in preparing the 4-inch sheets for reduction to half scale, and in extracting the *mauza* areas from fourteen of the 4-inch sheets. The outturn will be found fully detailed in the appendix.

(7) Solar Photographic Section.

462. The work of this section was conducted as usual, experiments with dry plates being also undertaken with a view to their use during the rains.

(8) Training School.

463. Eight pupils were entertained and instructed in topographical surveying. They were finally examined and posted to the various field parties requiring them.

The offices were inspected by the Surveyor-General in April, July and September 1897, and he was quite satisfied with the working of the several sections.*

III.—DRAWING OFFICE, SIMLA.

464. On the 13th of October 1896 Colonel Sir Thomas Holdich, Superintendent, 1st grade, made over charge of the Simla Drawing Office to Mr. Atkinson and left Simla for Ceylon on special duty; thence he proceeded on privilege leave to England. On Colonel Holdich's return from England, he resumed the charge of the Simla Drawing Office on the 6th April.

Personnel.

Colonel Sir T. H. Holdich, K C I.E., C.B., R.E., Superintendent, 1st grade.
Mr. G. W. E. Atkinson, Officiating Deputy Superintendent, 2nd grade.
" W. J. Cornelius, Extra Assistant Superintendent, 4th grade.
" R. R. Dickinson " " " 6th "
" F. E. Warde, Sub-Assistant Superintendent, 2nd "
" F. Rozario, Surveyor.
" H. Sindon, Draftsman.
Munshi Jafir Khan "
Mr. W. Manly "
and three other draftsmen and one writer.

465. Owing to alterations in the Army Head-Quarters Offices, orders were issued during the early part of the year to move the Simla Drawing Office into "Clermont," where the office continued throughout the winter months, returning to the old rooms in the Army Head-Quarters' building during April last.

466. The office has been fully occupied throughout the year, and it is satisfactory to note that the six sheets of Persia on the 16-mile scale have been finished and are now passing through the press at Dehra.

467. The office was inspected by the Surveyor-General in July.†

IV.—FOREST SURVEY BRANCH OFFICE, DEHRA DÚN.

468. The general direction and supervision of the head-quarters offices of the Forest Survey Branch remained throughout the year in the hands of Mr. W. H. Reynolds. The following branches of work were dealt with:—

i. Correspondence and accounts of the several provincial forest survey detachments.
ii. Computations and areas of the several field detachments.
iii. Up-keep of the Forest Department map records.
iv. Compilation and drawing of special maps for the Forest Department.
v. Training of surveyors.
vi. Other miscellaneous work for the Forest Department.

469. The up-keep of the provincial map records was maintained throughout the year. The alterations of the forest boundaries notified from time to time in the several Provincial Gazettes, have received attention, and the records have been revised accordingly, and all new tracts gazetted as state forests, have been located on the best available maps. The details of this branch of the work have been fully described in previous annual reports, hence it is not necessary to record them again, nevertheless this work continues to grow heavier year by year, as new tracts, especially in Burma, continue to be brought under forest management, and other forest tracts, more particularly in the Central Provinces, are disforested for agricultural purposes.

470. For the several Provincial Forest Departments a vast amount of map drawing has been got out of hand during the year. Seventy-eight special maps on various scales were prepared for the Forest Department, seventeen are in the press, and thirty-seven are in the different stages of progress. Of the 4-inch

* Mr. Peychers reports very highly of the work done by his Assistants, Messrs. Christie, McA'Fee, Higgs, LeFranc and Foster, and speaks well of the computers, draftsmen, accountant, and head writer of Computing Section.

The Superintendent reports very favourably of the assistance rendered him by Messrs. Christie and McA'Fee, also of the services rendered by Mr. J. Burbridge, the Head Clerk, and Babu Hira Singh, the second clerk of his office.

† The officer in charge, Simla Drawing Office, reports that Mr. Cornelius has maintained the same good character for work which has marked his career throughout, and that Mr. Dickinson is a painstaking and diligent assistant. Of the draftsmen it is said that they have all worked well, Messrs. Sindon and Rozario and Jafir Khan being specially mentioned. The services of the writer Ganga Ram are also specially brought to notice.

standard sheets of forest tracts surveyed by the Forest Survey Branch, 101 were published, 65 are in the press and 214 are in hand: many of the latter are nearly ready for the press. Two 1-inch standard sheets were also published and one is in the press and three 2-inch sheets are in progress.

471. A large amount of work of a miscellaneous nature was also turned out during the year. Under this head might be noted the colouring of 2,148 printed maps of various sorts, and the preparation of 345 tracings for various Forest and District Officers. To 124 printed maps, information was added regarding the distribution of forests, and 1,848 printed maps, on various scales, were cut up and mounted in book form for the use of the Forest Department and other branches of the Provincial Administrations.

472. During the year 28 men were instructed in surveying, *viz.*, 3 in the use of the theodolite, 21 in plane-tabling and 4 in the use of the spirit-level.*

* Mr. Reynolds speaks in the highest terms of Mr. Descubes; he is full of zeal and energy, is systematic and hardworking, and is a most excellent assistant. Mr. Watson is also reported as being a steady, reliable, and hard-working office hand.

Of the native establishment, Tulsi Ram, Mahomed Hassain, and Munzar Ahmed are spoken of as being good draughtsmen.

LIST OF MAPS AND CHARTS PUBLISHED AT CALCUTTA DURING THE YEAR 1896-97.

Title.	Scale.	Number of sheets.	Remarks.
Atlas of India.	In. M.		
Sheets Nos. 44 and 68	1=4	2	With additions and corrections to 1893.
Sheets Nos. 73, 107, 113, and 120	1=4	4	With additions to 1896.
Sheets Nos. 76 and 112	1=4	2	With additions to 1895.
Sheets Nos. 78 and 80	1=4	2	With additions to 1894.
Sheets Nos. 1A S.E.; 2 N.E.; 3 N.W.; 3 S.E.; 9 S.W.; 10 S.E.; 35 N.E.; 35 N.W.; 49 N.W.; 69 N.E.; 70 N.W.; 72 N.E.; 87 S.W.; and 130 N.E.	1=4	14	With additions to 1895.
Sheets Nos. 13 N.W. and 22 S.E.	1=4	2	With additions to 1890.
Sheets Nos. 13 N.E.; 33 S.W.; 33 S.E.; 91 N.W.; 124 S.W.; and 127 N.E.	1=4	6	With additions to 1893.
Sheets Nos. 20 N.E.; 32 S.W.; 33 N.W.; 34 N.W.; 51 S.W.; 53 S.E.; 53 S.W. and 72 N.W.	1=4	8	With additions to 1891.
Sheets Nos. 22 S.W. and 51 N.E.	1=4	2	With additions to 1889.
Sheets Nos. 21 N.E.; 27A N.E.; 36 S.W.; 40 N.W.; 78 S.W.; 79 N.W. and 125 S.E.	1=4	7	
Sheets Nos. 27A S.E.; 53 N.E.; 53 N.W.; 67 N.E.; 67 N.W.; 72 S.E.; 105 N.E.; 126 N.W.; 126 S.E. and 131 S.W.	1=4	10	With additions to 1896.
Sheet No. 31 N.E.	1=4	1	With additions to 1897.
Sheet No. 44A S.W.	1=4	1	With additions to 1892.
General Maps.			
Portion of Tibet, explored by Captain Deasy	1=8	2	
Provincial Maps.			
Assam	1=16	1	With additions and corrections to 1896.
Assam	1=16	1	With additions and corrections to 1897.
Central Provinces	1=32	1	With additions to railways to March 1896.
North-West Provinces and Oudh, showing Districts and States	1=16	2	
North-West Provinces and Oudh	1=32	1	With additions to March 1896.
Punjab	1=80	1	With additions to 1896.
Punjab and surrounding countries (skeleton)	1=32	1	With additions and corrections to railways, etc., to July 1896.
Divisional Maps.			
Chota-Nagpur	1=8	2	
Patna	1=8	2	With additions and corrections to January 1897.
District Maps.			
Bankura	1=4	1	
Bhamo and Myitkyina	1=8	1	With additions and corrections to boundaries to 1896.

Title.	Scale.	Number of sheets.	Remarks.
DISTRICT MAPS—*continued.*	In. M.		
Champarun	1=¼	1	With additions and corrections to boundaries, etc., to January 1896.
Dacca	1=¼	1	2nd edition. With additions and corrections to roads to July 1896.
Garhwal	1=2	6	
Gya	1=¼	1	With additions and corrections to boundaries and railways to 1896.
Hoshangabad	1=1	13	With additions and corrections to July 1895.
Khasia and Jaintia Hills	1=¼	1	
Lakhimpur	1=¼	1	With additions and corrections to boundaries and railways to August 1896.
Manbhoom	1=4	1	
Murshidabad	1=¼	1	With additions to February 1897.
Naini Tal	1=2	2	
Pabna	1=¼	1	With additions and corrections to May 1897.
Saran	1=¼	1	3rd edition. With additions and corrections to March 1896.
24-Parganas	1=¼	1	With additions and corrections to July 1896.
STANDARD MAPS.			
Bengal.			
Sheet No. 138	1=1	1	Preliminary edition.
Sheet No. 294	1=1	2	2nd edition.
Sheets Nos. 139, 246 and 391	1=1	3	
Bombay.			
Sheets Nos. 209, 246, 301, 302, 327, 329, 337 and 349	1=1	8	
Sheet No. 243	1=1	1	With additions and corrections to September 1896.
Burma (Lower).			
Hanthawaddy District—Sheets Nos. 277 $\frac{S.W.}{4}$ and 278 $\frac{N.W.}{2}$ (in one)	4=1	1	
Hanthawaddy and Pegu Districts—Sheet No. 278 $\frac{S.W.}{2}$	4=1	1	
Pegu District—Sheet No. 278 $\frac{S.W.}{4}$	4=1	1	
Sheets Nos. 181 and 182	1=1	2	2nd edition.
Sheets Nos. 420, 425, 426, 427, 428, 475 and 479	1=1	7	
Sheet No. 184	1=1	1	With additions and corrections to January 1897.
Burma (Upper).			
Sheet No. 126	1=1	1	
Sheets Nos. 306 and 358	1=1	2	Preliminary edition.

Title.	Scale.	Number of sheets.	Remarks.
STANDARD MAPS—*continued*.	In. M.		
Central India and Rajputana.			
Sheet No. 260	1=1	1	2nd edition. With additions to railways to 1896.
Central Provinces.			
Betul District—Sheets Nos. 24 S.E./4; 25 N.E./4 and 25 S.E./2	4=1	3	2nd edition.
Sheets Nos. 25 S.E./4; 27 S.W./3; 35 S.E./1; 35 S.E./3; 35 S.W./3; 35 S.W./4; 36 N.E./1; 36 S.W./1; 36 S.W./2; 36 S.W./3; 36 S.W./4; 35 S.E./1 and 36 S.E./3 (in one), and 37 N.W./2	4=1	13	
Hoshangabad and Betul Districts—Sheets Nos. 24 S.E./2; 35 N.E./3 and 35 N.E./4 (in one) and 35 S.W./2 . .	4=1	3	2nd edition.
Sheet No. 35 N.W./4	4=1	1	
Damoh District—Sheets Nos. 61 N.E./4; 62 S.W./2 and 4 and 62 N.W./4 (in one) 63 S.E./2; 81 N.E./3; 81 S.E./1; 81 S.W./4; 82 N.W./1 and 82 N.W./2 (in one); 83 S.W./1 and 84 N.W./1	4=1	9	
Sheet No. 51	1=1	1	With additions to roads to 1896.
Gujarat.			
Sheet No. 29	1=1	1	
Indus Riverain.			
Sheets Nos. 18; 33; 34; 35; 36; 49; 50; 51; 52 and 53 .	1=1	10	
Sheets Nos. 18 and 35 (in one), 33, 34, 36, 49, 50, 51, 52 and 53	1=1	9	Skeleton.
Madras.			
Sheet No. 24	1=1	1	2nd edition.
North-Western Provinces and Oudh.			
Sheet No. 63	1=1	1	2nd edition.
Punjab.			
Hoshiarpur District—Sheet No. 265 S.W./3	4=1	1	
Kalsia State Forests—Sheet No. 314 S.E./2 . . .	4=1	1	
Kangra District—Sheets Nos. 264 S.W./4; 265 N.W./1; 265 N.W./2; 265 N.W./3 and 265 [illegible]/4	4=1	5	

Title.	Scale.	Number of sheets.	Remarks.
STANDARD MAPS—*concluded.*			
Punjab—continued.	In. M.		
Kangra and Hoshiarpur Districts—Sheets Nos. 265 $\frac{S.W.}{1}$; 265 $\frac{S.W.}{2}$ and 265 $\frac{S.W.}{4}$	4=1	3	
Patiala State Forests—Sheet No. 290 $\frac{N.E.}{4}$	4=1	1	
Kangra District—Sheet No. 265 N.E.	2=1	1	
Kangra District and Mundi State—Sheet No. 285 S.E.	2=1	1	
Simla District—Sheet No. 311 S.W.	2=1	1	
North-Eastern Frontier Series.			
Sheet No. 15 S.E.	1=4	1	7th edition.
Sheet No. 15 N.W.	1=4	1	
Sheet No. 15	1=8	1	4th edition.
South-Eastern Frontier Series.			
Sheet No. 2 N.E.	1=4	1	6th edition. With additions to boundaries and roads to February 1896.
Sheet No. 4 N.W.	1=4	1	6th edition.
Sheet No. 4 S.W.	1=4	1	7th edition. With additions and corrections to September 1896.
Sheet No. 6 N.E.	1=4	1	
Sheets Nos. 9 and 10	1=8	2	
PLANS OF CITIES AND CANTONMENTS.			
Simla	16=1	8	Revised to 1896.
Ajmere in Rajputana	12=1	7	With additions and corrections to April 1896.
Dehra Dun Municipality and Cantonments	12=1	3	2nd edition.
Dharwar City and Environs, 1894-95	8=1	2	
Calcutta	6=1	1	
Sanitaria of Simla and Jutog	3=1	1	Skeleton. With additions to 1897.
Calcutta and surrounding country, with table of distances	1=1	1	
Ditto ditto ditto	1=1	1	2nd edition.
INDEX MAPS.			
To the standard sheets of Central India and Rajputana, Sheets Nos. 1 and 2	...	2	With additions and corrections to 1897.
To the standard sheets of the Central Provinces	...	1	With additions and corrections to 1897.
To the standard sheets of the Bombay Presidency	...	1	With additions and corrections to 1897.

Title.	Scale.	Number of sheets.	Remarks.
STATISTICAL MAPS.	In. M.		
Canal map of India, 1897	1=32	6	
Railway map of India	1=48	4	Railways brought up to 31st March 1897.
India showing Railways	1=64	2	Corrected to 31st December 1896.
India showing Railways	1=80	1	With corrections to 1897.
ADMINISTRATION REPORT MAPS.			
Bannu, Cawnpore, Champaran, Chindwara, Darbhanga, Dinajpur, Goalpara, Gurdaspur, Gujranwalla, Jalpaiguri, Jessore, Jhang, Jullundur, Khulna, Mandla, Multan, Nimar, Rawal Pindi, Rungpur, Sarun, Saugor, Seoni, Shahabad, Sonthal Parganas, Wardha	1=8	25	
Naini Tal	1=10	1	
Balaghat, Kangra	1=12	2	
Chanda, Gurhjat States, Lohardaga, Sambalpur	1=16	4	
Upper Burma	1=64	1	With additions and corrections to 1896.
MISCELLANEOUS.			
Alapalle reserved forest; Palmaner Taluk; North Arcot District, Madras	4=1	1	
No. 122 Varatanapalle reserved forest and Varatanapalle extension proposed reserve; Krishnagiri Taluk; Salem District, Madras	4=1	1	
No. 124 Vallemalai reserved forest, Palur Taluk; North Arcot District, Madras	4=1	1	
Burma-Siam boundary. Sheets Nos. 1 to 6	1=1	6	
Bajour and adjacent countries	1=4	2	
Parts of Sheets Nos. 23 N.W. and 23 N.E. of the North-East Frontier (country round Myitkhina)	1=4	1	
Waziristan	1=4	1	
Route map for the Western Himalayas; Kashmir, Punjab and Northern India; with portions of Afghanistan and Baluchistan, &c.	1=32	1	With additions to railways to 1896.
Map showing the path and limits of totality of the total Eclipse of the sun in India on the 21st January 1898	1=64	1	
Conventional signs to be used on Topographical maps	...	1	With additions and corrections to 1896.
Conventional signs to be used on Topographical maps	...	1	With additions and corrections to 1897.
TRIANGULATION CHARTS.			
Central Provinces. Sheets Nos. 62, 65, 66 and 81	1=2	4	
Gujrat Survey. Degree Sheet No. 1 (Northern portion), seasons 1884-87	1=2	1	
Gujrat Survey. Degree Sheet No. 1 (Southern portion), seasons 1884-87	1=2	1	
Gujrat Survey. Degree Sheet No. VII (Northern portion), seasons 1884-89	1=2	1	
Gujrat Survey. Degree Sheet No. VII (Southern portion), seasons 1877-78-81-82 and 1887-88	1=2	1	
Punjab Survey. Sheets Nos. 311; 314 and 336	1=2	3	

Title of Map.	Scale.	Number of sheets.
STANDARD MAPS.	In. M.	
BURMA.		
Fyinmana Forest Survey.		
Sheets Nos. 223 $\frac{\text{N.E.}}{1}$, $\frac{\text{N.E.}}{2}$, $\frac{\text{N.E.}}{3}$, $\frac{\text{N.E.}}{4}$, $\frac{\text{S.E.}}{1}$, $\frac{\text{S.E.}}{2}$, $\frac{\text{S.E.}}{3}$, $\frac{\text{S.E.}}{4}$; 224 $\frac{\text{N.E.}}{1}$, $\frac{\text{N.E.}}{2}$; 270 $\frac{\text{S.W.}}{3}$, $\frac{\text{S.W.}}{4}$; 271 $\frac{\text{N.W.}}{1}$ and $\frac{\text{N.W.}}{2}$	4=1	14
Salween-Ataran Forest Survey.		
Sheets Nos. 477 $\frac{\text{N.E.}}{4}$ and $\frac{\text{S.E.}}{2}$ (parts of); 549 $\frac{\text{N.W.}}{3}$, $\frac{\text{S.W.}}{1}$, $\frac{\text{S.W.}}{3 \& 4}$; 550 $\frac{\text{N.W.}}{2}$, $\frac{\text{N.W.}}{4}$ (part of), $\frac{\text{S.W.}}{2}$, $\frac{\text{S.W.}}{4}$, $\frac{\text{S.E.}}{1}$ and part of $\frac{\text{S.E.}}{2}$, $\frac{\text{S.E.}}{3}$, $\frac{\text{S.E.}}{4}$; 551 $\frac{\text{N.W.}}{2}$, $\frac{\text{N.E.}}{3}$ and part of $\frac{\text{N.W.}}{4}$ . . .	4=1	13
CENTRAL PROVINCES.		
Bhandára Forest Survey.		
Sheets Nos. 94 $\frac{\text{S.E.}}{1}$, $\frac{\text{S.E.}}{3}$, $\frac{\text{S.E.}}{4}$; 95 $\frac{\text{N.E.}}{1}$; 96 $\frac{\text{N.E.}}{2}$; 116 $\frac{\text{N.W.}}{3}$, $\frac{\text{S.W.}}{1}$; 117 $\frac{\text{N.W.}}{2}$ (part o), $\frac{\text{N.W.}}{3}$, $\frac{\text{N.W.}}{4}$, $\frac{\text{N.E.}}{3}$ and $\frac{\text{S.E.}}{1}$, $\frac{\text{S.W.}}{2}$, $\frac{\text{S.W.}}{4}$, $\frac{\text{S.E.}}{3}$ and 118 $\frac{\text{N.E.}}{1}$ and 118 $\frac{\text{N.W.}}{2}$	4=1	15
Bálághát Forest Survey.		
Sheets Nos. 91 $\frac{\text{S.E.}}{2}$, 92 $\frac{\text{N.E.}}{3}$ and part of $\frac{\text{N.E.}}{1}$; 112 $\frac{\text{N.W.}}{2}$; 113 $\frac{\text{N.W.}}{1}$ and $\frac{\text{N.W.}}{3}$	4=1	5
Jubbulpore Forest Survey.		
Sheet No. 109 $\frac{\text{S.W.}}{2}$	4=1	1
Narsinghpur Forest Survey.		
Sheets Nos. 47 $\frac{\text{S.E.}}{3}$ and 48 $\frac{\text{N.E.}}{1}$ (parts of); 49 $\frac{\text{S.E.}}{4}$, 50 $\frac{\text{N.E.}}{2}$, 67 $\frac{\text{S.W.}}{3}$ and 68 $\frac{\text{N.W.}}{1}$ (parts of); 50 $\frac{\text{N.W.}}{2 \& 4}$ and $\frac{\text{N.E.}}{1 \& 3}$ (parts of); $\frac{\text{N.W.}}{4}$, $\frac{\text{N.E.}}{3}$ and $\frac{\text{S.E.}}{1}$ (parts of); 66 $\frac{\text{N.W.}}{2}$ (part of), $\frac{\text{N.E.}}{1}$, $\frac{\text{N.E.}}{4}$ (part of), $\frac{\text{S.W.}}{2}$ (part of); 67 $\frac{\text{N.E.}}{4}$ (part of), $\frac{\text{S.E.}}{1}$, $\frac{\text{S.E.}}{2}$, $\frac{\text{S.E.}}{3}$, $\frac{\text{S.E.}}{4}$; 68 $\frac{\text{N.E.}}{2}$, $\frac{\text{N.E.}}{4}$; 86 $\frac{\text{S.W.}}{4}$ and 87 $\frac{\text{W.}}{2}$ (parts of); 87 $\frac{\text{N.W.}}{1}$, $\frac{\text{N.W.}}{3}$, $\frac{\text{N.W.}}{4}$ and $\frac{\text{S.W.}}{2}$ (parts of) and $\frac{\text{S.W.}}{1}$	4=1	20
Nágpur-Wardhá Forest Survey.		
Sheets Nos. 73 $\frac{\text{N.W.}}{1}$, $\frac{\text{N}}{2}$; and 93 $\frac{\text{N.W.}}{1}$	4=1	3
Ráipur Forest Survey.		
Sheets Nos. 188 $\frac{\text{N.E.}}{3}$, $\frac{\text{S.E.}}{1}$, $\frac{\text{S.E.}}{2}$; 189 $\frac{\text{N.E.}}{2}$, $\frac{\text{N.E.}}{4}$; 206 $\frac{\text{N.E.}}{4}$ (part of), $\frac{\text{S.W.}}{4}$ and 207 $\frac{\text{N.W.}}{2}$, $\frac{\text{S.E.}}{1}$, $\frac{\text{S.E.}}{2}$, $\frac{\text{S.E.}}{3}$; 207 $\frac{\text{N.E.}}{1}$, $\frac{\text{N.E.}}{3 \& 4}$; 210 $\frac{\text{N.W.}}{1}$, $\frac{\text{N.W.}}{2}$, $\frac{\text{N.W.}}{3}$, $\frac{\text{N.W.}}{4}$; and $\frac{\text{S.W.}}{1}$ and $\frac{\text{S.W.}}{2}$ (part of) .	4=1	18

Title of Map.	Scale.	Number of sheets.
STANDARD MAPS—*contd.*		
NORTH-WESTERN PROVINCES AND OUDH.	In. M.	
Gonda Forest Survey.		
Sheets Nos. 158 $\frac{\text{S. E.}}{1}$ (part of); 159 $\frac{\text{N. E.}}{4}$; 172 $\frac{\text{N. W.}}{2}$, $\frac{\text{N. W.}}{3}$, $\frac{\text{N. E.}}{3}$, $\frac{\text{S. W.}}{1}$ and $\frac{\text{S. W.}}{2}$ and $\frac{\text{S. E.}}{1}$ (parts of)	4=1	7
Kheri Forest Survey.		
Sheets Nos. 113 $\frac{\text{S. W.}}{4}$; 114 $\frac{\text{N. W.}}{2}$, $\frac{\text{N. E.}}{1}$, $\frac{\text{N. E.}}{3}$, $\frac{\text{N. E.}}{4}$ and $\frac{\text{S. E.}}{1}$.	4=1	6
Lalitpur Forest Survey.		
Sheets Nos. 41 $\frac{\text{S. E.}}{2}$, $\frac{\text{S. E.}}{4}$; 42 $\frac{\text{N. E.}}{2}$, $\frac{\text{N. E.}}{4}$; 43 $\frac{\text{S. E.}}{3}$ and part of $\frac{\text{S. E.}}{4}$; 44 $\frac{\text{N. E.}}{4}$ and part of $\frac{\text{N. E.}}{3}$; 59 $\frac{\text{S. W.}}{1}$ and part of $\frac{\text{S. W.}}{3}$; 60 $\frac{\text{N. W.}}{4}$ (part of), $\frac{\text{S. W.}}{1 \& 2}$ (parts of); 61 $\frac{\text{S. E.}}{2 \& 4}$ (parts of); 62 $\frac{\text{N. W.}}{3}$, and $\frac{\text{S. W.}}{4}$	4=1	12
PUNJAB.		
Bashahr Forest Survey.		
Sheet No. 332	1=1	1
Index Maps.		
Index to the Forest Survey in the Bahraich, Gonda and Gorakhpur Division .	1=16	1
" " " " Bundelkhand Division	1=8	1
" " " " Salween-Ataran Division	1=32	1
" " " " Pyinmana District	1=8	1
" " " " Chamba State	1=8	1
Index showing progress of Forest Surveys in the Central Provinces . . .	1=32	1
Charts.		
Bashahr Forest Survey Chart of Triangulation, Sheet No. 333	1=1	1

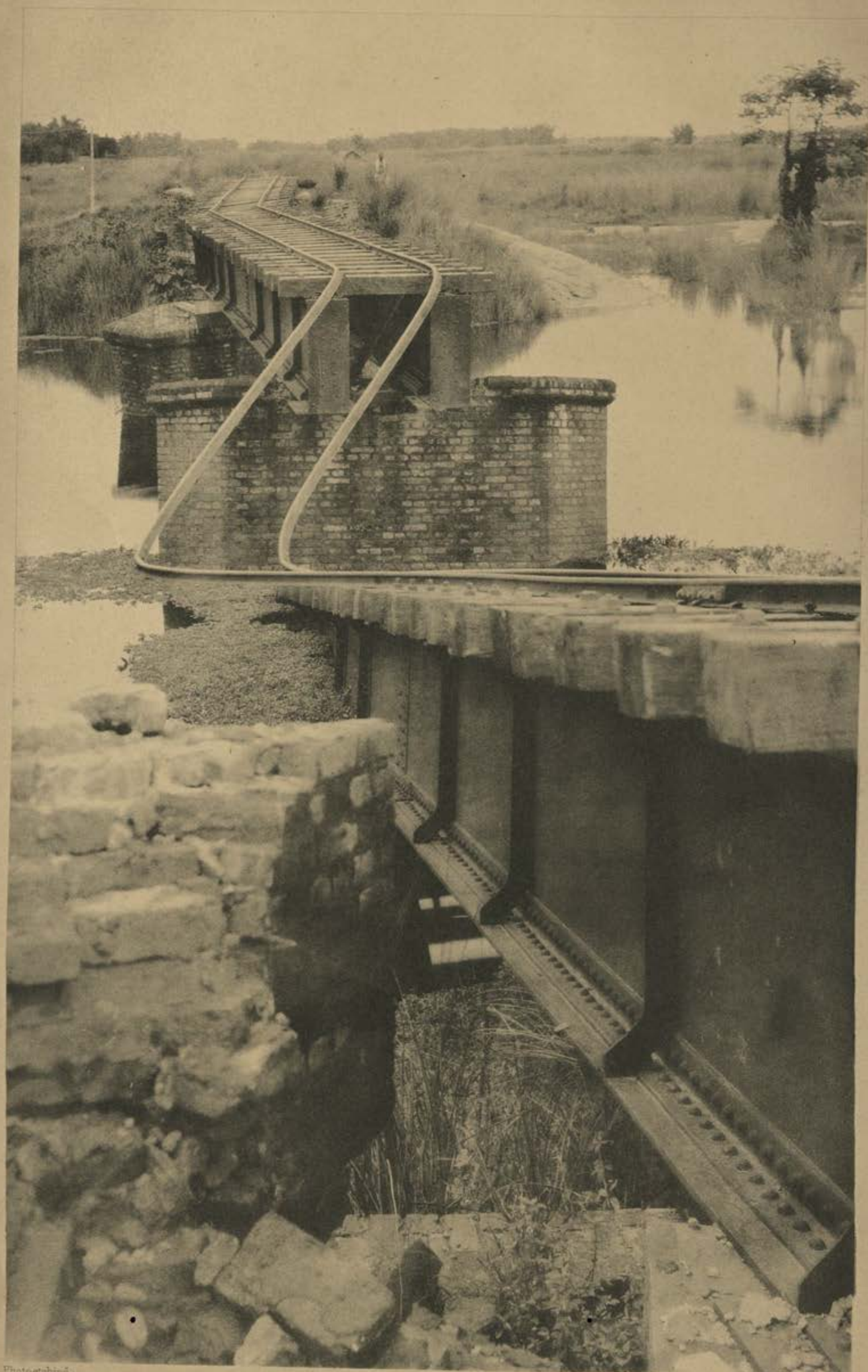


Photo-etching.

Survey of India Offices, Calcutta, March 1898.

MANSHAI BRIDGE, COOCH BEHAR STATE RAILWAY.

After the earthquake of 12th June 1897.

APPENDIX

EXTRACTS

FROM

REPORTS BY EXECUTIVE OFFICERS.

BALUCHISTAN.

Statement of the outturn of work executed by No. 24 Party during season 1896-97.

Description of Details.	
Number of stations newly fixed	7
" " figures completed	3
Length of series in miles completed	75
" " approximate series in miles in advance	23
Area of triangulation in square miles	1380
Average triangular error in seconds	0″·44
Astronomical azimuth of verification	1
Average probable error of angles in seconds	0″·17
Number of principal stations selected in advance	3
" " station platforms constructed	8
" " stations placed under official protection	...
" " " the elements of which have been computed	7
Area embraced by the triangulation to points exterior to main triangulation in square miles.	1,200
Number of secondary points fixed	7
" " stations and points the heights of which have been determined.	14
Number of miles of rays and paths cleared	...
" " preliminary charts of triangulation	2
" " hill tops cleared of jungle	...
Mean co-efficient of refraction	·066

Extract from the Narrative Report of CAPTAIN J. M. BURN, *R.E., Officiating Deputy Superintendent, 1st grade, on the Trigonometrical Operations in South-East Balúchistán.*

The season has been an exceptional one, owing to the somewhat peculiar and at times often dangerous circumstances under which we have had to carry out the work. It was towards the end of the season 1895-96 that the Jam of Las Bela died, and as our work was to commence this year in the Jam's territory, the thorny question of the succession to the title became one of more than ordinary interest to us. When we left Bela last year in April, the second son of the Jam was in temporary rule, but during the recess season the elder son was, by the orders of the Government, installed on the *gaddi*. He, however, soon began to have serious differences with the Political Agent, and the result was that I had to make my movements dependent on those of the Political Agent of South-East Balúchistán, a matter, as it turned out, of considerable difficulty. For about a month before our start, I got a letter at Mussooree from the Political Agent saying he would leave Kurrachee definitely on October 28th, and, as I had made all my arrangements accordingly, it was not with any feeling of pleasure, when in the middle of October I suddenly got the information that the start was to be made on October 23rd. The result of this was that I only had three days in Kurrachee to make all the arrangements for the coming field season.

As the country we had to traverse could produce absolutely no supplies of any kind that my *khalásis* could live on, the difficult and irksome task of getting together enough food for about 200 men for six months was thus rendered all the more troublesome. However, in three days I had everything ready, and on 23rd October I crossed the frontier into Balúchistán, only to find however, as the first march was done independently, that the escort for the Political Agent had been unable to leave Kurrachee on the fixed day, owing to the insufficiency and inferiority of the camels that had been supplied for its use. As only a few months before we had traversed the same ground, *viz.*, from Kurrachee to Las Bela, without any escorts at all, it seemed somewhat strange to see 200 men of the 3rd Balúch Regiment marching along with us and the Political Agent with his personal escort of some 50 Sind Horse.

Nothing eventful happened on our march of eight days to Bela, but to make matters the safer, all the men in camp were practised at falling into their places in case of any night alarm, and our camps were pitched with precautions in case of any attack.

By November 1st we reached Bela, and outside the city were met by the new Jam and all his numerous followers, amongst the latter being a hundred men, armed with all sorts of strange and quaint weapons, attended by about the most novel band I have ever seen, who were just able to twang out a tune, which after some consideration one assumed must be "God save the Queen."

On arrival at Bela, the first thing we had to do was to get our camp into a thoroughly defensible state, for no one knew what the events of the next few days might not bring forth. I put my *khalásis* on to throwing up a small redoubt close to the camp, in which all the powder, which was taken from the city, was to be stored.

* * * * * * *

By November 12th, we were ready to start operations. I went off towards (from Bela) the eastern stations of Kuliri and Piaro, where we closed last year. Messrs. Hickie and Prunty I sent off to the western stations of Gird and Goko, to place the lamp squads on these hills and make the necessary arrangements for the water supply of the men on these hills, for the water in both cases was some eight miles from the mark, so consequently had to be brought daily by camels.

By 19th November I had finished Kuliri H.S., and was just finishing off Piaro H.S. (where I observed an azimuth) when, in the midst of most favourable weather, on November 28th, I got a letter from Mr. Prunty to say his work had been completely stopped and the whole country ahead was unfriendly. This was far from pleasant reading, but there was nothing to be done except that I should myself push forward, and see what soft words could accomplish.

By December 5th I got out to a place called Mach, half-way between Bela and Jháu, having in the meantime been again enlivened with a letter from Mr. Hickie, to very much the same purport as the one I had lately received from Mr. Prunty. I met both of the above Assistants at Mach, and discussed matters with them. I found here that a son-in-law of Sardar Saffar Khan of Jháu had been out at our Mach camp, but that he had evidently been playing his own game entirely, and, far from helping us, had even been doing underhand things to thwart us in our work. I never had the satisfaction of an interview with this gentleman, for when he heard I was coming into camp, he cleared out and I never had a chance again of seeing him. I at once sent off Rahim Khan (the responsible Jamadar sent from Kalát) to Jháu with a carefully but strongly worded letter to Saffar Khan. Briefly, I wrote to this effect, "My work has been stopped. You are the "responsible man in these parts, and I decline absolutely to discuss matters with any one "else except you. If you won't come here, then I must come to you. I shall pitch my "camp at Jháu, and simply tell the Government that you alone are responsible for any "loss of money that occurs, probably about a lakh of Rupees." Just as I was on the point of starting for Jháu, I was suddenly taken very ill with what I at first thought

was going to be cholera, but it turned out to be only the effects of a bad chill, but for three days I was unable to move; however, no delay really occurred, for Sardar Saffar Khan actually did come out to meet me. It would be as well here if I gave you a short description of this man, for he played an important part in our affairs this past season.

This man is the Chief Sardar in the Jháu district, while his elder brother is the head man of the influential tribe of the Bizenjhaos, and lives at Nál, an important town north of Bela. Saffar Khan is not, I believe, on very good terms with the political authorities of Kalát. He is an old man, and has all his life, from what I heard from Captain Le Mesurier, shewn a decided antipathy to all Europeans and has never been known to voluntarily help them in any way if he could avoid doing so. Consequently when he arrived in my camp, I was agreeably surprised.

I was confident that if I could only once get face to face with him, I would soon get him to do what I wanted, and as events have shewn, I was correct in my surmise. When I sent for him to talk over matters, I met him with as much ceremony as I could, asked him to come and sit down in the largest tent I had at my disposal, and for the next few hours we had an animated discussion.

To have no misunderstandings, I myself first spoke what I had to say in English to my recorder; this was given in Hindustani to Rahim Khan, and he in his turn translated my words into Balúchí. I first of all carefully explained the objects of our survey, and its entirely non-political character, that I was glad to meet him face to face, for I could now ask him point blank whether he meant to help me or not. He here expressed his willingness to do anything I wanted. I then said that what I wanted was, that he should give to each of my working squads one really influential man to accompany them, and each lamp squad should have one or two men, to be obtained locally, who would remain with or near the squad until the work was done, and who would have to personally guard the men of the squads. These details were all satisfactorily arranged, and the rate of wages for the services to be rendered settled, when he in his turn asked some favours of me.

First, that I should pardon his son-in-law Mir Omar Khan for the unsatisfactory way he had lately been behaving, and that I should not indent on him for any camels or supplies, as he had none of either to spare. I agreed to these conditions, and after a few amicable remarks our meeting ended.

It was a satisfactory one, and I felt somewhat pleased, for I believe I am the only European that he has ever gone out of his way to assist at all, and the only pressure I could bring to bear on him was purely of a moral kind. We all marched off again from Mach to our respective stations, and the rest of the season, when in Jháu territory, had no more bother to speak of with any of the inhabitants.

The third station I observed at was Gird H.S. It was with considerable difficulty that a path was made up this hill, for it is precipitous on almost every side. However one was obtained, but it was with a feeling of distinct relief that I got the instrument, and myself, down the hill again, all safe and sound.

On the way to Goko H. S., the next station, I went *viá* Bela, and was lucky enough to be able to halt there and spend Xmas day amongst genial friends, a thing I have not been able to do for a good many years now. I finished off Goko by January 6th and then went on to the central station of Dosar or Dilcki. I had a great deal of trouble and worry with this station, for to begin with, the ground round about the hill belonged to a most unruly fellow of the name of "Rozi." Mr. Hickie, who built the station, never saw him. I from Goko sent off a messenger to Rozi to tell him to send me a guide. He sent a guide, but evidently told him to take good care he did not take me by the only practical route which went to Rozi's village, but to make me come, with my camels, if possible, by a track only fit for unloaded men. After two days' marching and making about eight miles of path, I found myself at the foot of a range, towering some 2,000 feet above me, nearly all solid rock at a sharp incline, over which the guide said we must go. I at once went up the hill, from the top of which I could see Rozi's *got* or village only a few miles away, but saw at once I couldn't possibly make a path, even for half-laden camels, under three or four days, so I came down that hill determined to have it out with the guide. When I got hold of him, I made him a prisoner, and said I would send him into Bela to the Political Agent. I thoroughly frightened him, and the result was that I got at the truth, and that the facts were that he was a comparative stranger to the country and had only been temporarily stopping with Rozi. He knew there was another way, but swore he had never traversed it. Next morning we retraced our steps, and I had one of the hardest marches I have ever had. To go only some three miles in a straight line, we certainly covered over 25, over about as bad ground as it was possible for camels to go. I kept ahead the whole day, with a small squad of men, repairing the track as fast as I could.

About midday, just as we were on the worst bit of the road, crossing over a range about 2,500 feet high, it began to rain heavily, and we were soon all soaked. We could only get the camels along by continually throwing down fine sand on the slippery rock so as to give the animals a foothold. I had about 30 camels with me, but the going was so bad, that on that march, two laid down, absolutely refused to move on and finally died where they lay. On getting to Dosar H. S., I immediately sent off for Rozi, who after some delay, turned up in my camp with a few of his followers, all armed to the teeth, evidently mistrusting my intentions. However, I was again able to persuade him of my entirely pacific work, but soon found out that he wanted to be considered quite independent of the other Chiefs around him, and what he really wanted was to get some

money out of me. I consequently promised him that I would reward him with the sum of R50 if he undertook that my squad on the hill should, later on, be sent into Jháu without having suffered any molestation. He at once jumped at these terms, which were finally faithfully carried out on both sides. I sent the observatory tent and some of the kit up the hill on January 13th, meaning to go up myself next day. Most fortunate it was that I did not go up, for about midday it began to blow very hard and by the evening a cyclone was blowing, and the temperature fell rapidly. It froze hard that night, so much so that the water in the bath room of my tent was frozen solid. Next morning things were even worse, and knowing the men on the hill must have had an awful night of it, I called for some volunteers, and went up the hill myself. It was all I could do to get up, for the force of the wind, was tremendous and the cold intense. When I got up I found that the observatory tent had been blown down, and had fared somewhat badly (of course the instrument was not up), while all the men I had sent up the day before were lying in a half unconscious state, huddled up together under a blown down shouldari. I got the observatory tent at once collected together, and took it, and all the men, down the hill to our camp at the foot as quickly as possible. This intense cold continued for another two or three days, but the violent wind had raised such a thick dust that I could not begin observing at this station until January 20th, and could not get to the foot of Washapi H. S., the next station, until the end of the month.

The path between these two stations, nearly every inch of it having been made by us, went over some very bad ground, for Washapi is another almost inaccessible hill, absolutely precipitous on its western face, and most difficult to approach from the east, for the only way of getting up is to clamber over huge boulders in the bed of a stony nulla coming down from near the top of the hill. Had my observatory tent been blown over to the west on this hill, it would have gone down a sheer precipice for a thousand feet. What with clouds and mist, and then hazy weather, owing to the dust thrown up by the wind, I could only get the observations done after much delay and trouble, and did not leave this station until February 8th, when I marched on to Jháu, where my head-quarter camp was. I found that there were only the ruins of an old village here, and that though Saffar Khan had lived here at one time, he was living now some eight miles to the north. However, I had a secondary station here, and as it lies close to the main track between Las Bela and Kej, the point here obtained, visible from four principal stations, should be a useful one.

The next two stations were Buzgalaband and Hazarbuzi, both lying to the west of the Jháu plain, but owing to most vexatious and wearisome delays, caused by the dust for ever being thrown up by an ever persistently blowing south-westerly wind, it was not until March 12th that I was able to leave Hazarbuzi, when matters were beginning to get somewhat critical, for unless I could get the observations finished at Kappar by March 21st, the date on which I had made up my mind some time before as the day on which all work must absolutely cease, if I were to get the men into Ormára by April 10th, in time to catch the steamer for Kurrachee, then the quadrilateral on the diagonal Washapi-Kappar would not be finished this season, much delay and difficulty would be caused next year, and the outturn for 1896-97 would be a very small one. I got to Kappar from Hazarbuzi in a forced march of one day, the men being some 18 hours on the march, and got a clear day to start work on, but next day the wind arose again, and one could barely see a few yards on account of the all-pervading dust. However, after some anxious nights of it, spent in vainly trying to see the lamps on the surrounding stations, I was, to my immense relief, able to finish off the eastern angles at Kappar by March 20th; but it was quite impossible to get the angles to the west done, so this station must be visited again this coming season, work starting again on the base Hazarbuzi-Kappar. I got into Ormára by April 2nd, being delayed somewhat on the long march of 13 days from Kappar to Ormára by fever, which kept me to my bed for a few days. Here I had a good deal to do one way and another in arranging for the storing away of our kit until next season, and for the embarkation of the party in a British India steamer, which embarkation was safely effected on April 10th. The steamer could only anchor some five miles from shore, and it was rather anxious work getting all the men and kit out to the steamer in safety, but no casualty occurred. The difficulty of rationing the men has been one that has caused me much anxiety this past season, but I am glad to say we never ran short for a single day, but I had too much left over at Ormára which my *khalásis* could not eat up. Fortunately however, owing to the fact that this port had established a ten-days quarantine on all arrivals from Kurrachee, I was able to dispose of the surplus rations at the prices I had given for them, to a local *bania* there.

On the whole I found it fairly easy to get along with all the inhabitants of Balúchistán, whom I met on my work. They are an independent set of fellows, all very lazy and indolent, but almost without exception extremely poor, and at the same time very avaricious, so if one wants anything done, one can generally get it done, if patience and tact be exercised, providing one shews one is willing to pay for their services. They have been willing enough to sell us sheep and goats whenever required at rather enhanced rates.

The Jamadar Rahim Khan whom the Political Agent of Kalát sent me was certainly of great assistance. He knew all about the local Sardars, and the sections of the tribe they belonged to, so that, backed up by the *perwanas* he had from Kalát, he was generally able without much bother to get the services of local men to shew the forward parties the way to the hills and so on. He brought, however, some utterly useless sowars with

him, some mounted on miserable ponies, quite incapable of keeping up on a march with a riding camel.

I had about a dozen of these men originally, but I dismissed two summarily for gross disobedience of orders, one ran away, and another resigned, so that their numbers were considerably reduced by April. Throughout the whole season the quality of the water available was a source of much annoyance. When camped near any fairly big river with running water, such as at Bela and at Jhāu, it was all right, but in other places it was often very bad indeed, full of salts, which often had a very deleterious effect on one.

The health of the men has on the whole been fairly good, though I regret to have to record the death of 7 men, 4 during the field season and 3 during the recess season, the results, I am afraid, of the unavoidable privations they had to undergo.

The fact was that when the men joined, a good many of them had not had an honest square meal for months owing to the famine, and consequently began gorging when they could get as much atta as they liked, with the result that dysentery was pretty common at the beginning of the season. However, at the close of the season all the men were about as fit as they could be, shewing a marked difference to what they were six months before. The party reached Kurrachee by the middle of April, and Mussooree by the end of the same month.

Extract from the Narrative Report by LIEUTENANT W. M. COLDSTREAM, *R. E., Officiating Deputy Superintendent, 2nd grade, on the Survey Operations with the expedition into the Southern Chin Hills, season 1896-97.*

The general plan of the operations in the Southern Chin hills for the winter of 1896-97 was as follows:—

Three columns of 100 men each were to enter the hills by different routes and concentrate on the Eastern slopes of the Arakan Yomas at the Chin village of Myaing, at which place the subsequent movements of the columns were to be decided on.

No. 1 column was to start from the Burman village of Laungshe in the Pakôkku district, whence a comparatively good road suitable for pack animals led to Chatwe (Chindwe) in the Môn valley a few marches south of the rendezvous.

No. 2 column was to start from Mindat-sakan, a military post some 30 miles north of Laungshe on the Chin border, and to work through the high hills of the Mount Victoria range to the Môn valley, halting when necessary to exact punishment for the raid on Mindat-sakan of the previous year.

No 3 column was to start from Paletwa in Arakan and to reach Myaing by a route through the Arakan hill tracts.

The date of rendezvous at Myaing was settled for the beginning of January.

The survey party consisting of myself with Sub-Surveyors Abdul Rahim, Ramsabad and Mowni Ram with 30 followers, was disposed as follows:—Sub-Surveyor Abdul Rahim was to accompany the Arakan column, while I accompanied the 2nd (or Mindat-sakan) column, keeping one sub-surveyor with me and sending the other with No. 1 (the Laungshe) column.

On arrival at Pakôkku on the 11th November, I ascertained that Mr. Ross the Political Officer of No. 2 column, intended to leave Mindat-sakan on the 1st December, and that the 1st column was to start from Pakôkku for Laungshe within a few days. By the 10th Mr. Ross, I.C.S., Lieutenant Barnard, Commanding the Escort, Lieutenant Fleming, 100 Sikhs of the Military Police, the survey party and 200 coolies had collected at Mindat-sakan, and on the 11th we started. I made a detour to visit and observe at Bawkung Tung or Mount Kitchen, a hill of 8,000 feet elevation, some 7 miles off the main route. Up to this date, the 12th of December, the work was heavily handicapped by the thick masses of cloud which shrouded the higher peaks, and only lifted very occasionally for short periods. After this, however, until the middle of January, when the usual Burman haze began, the weather was clear and in every way favourable for survey work.

I rejoined the main body on the 13th, and by the 22nd we reached Tawim. At this village I again left the main body, and after two stiff marches arrived within a mile of the summit of Mount Victoria: as my party had to rejoin the main body at a village (M'leng) to which the distance from Mount Victoria was not known, I could only spend one day on the summit. Although at the site of my station shortly after dawn, it was midday before the sepoys and *khalasis* had sufficiently cleared the hill for me, to commence observing and when darkness came on I had not obtained as many observations as I had hoped for. That night we bivouacked at the summit, but unfortunately the next morning proving cloudy no more work was possible and after a long downhill march we rejoined the main body at M'leng in the afternoon. On this trip the sepoys and followers suffered considerably from the cold, Mount Victoria being 10,100 feet in elevation, and we had 8 cases of fever and 2 of dysentery in the party, which consisted of 20 sepoys, 7 *khalasis* and 27 coolies.

From M'leng I remained with the main body until we reached Myaing on the 3rd January, where we found the Arakan column with Mr. Greenstreet and Captain Rigby. The Laungshe column marched in the same day, and I was glad to find that the surveyors with each party had mapped in a large extent of country. I again left the force taking all 3 surveyors with me, and we visited a couple of peaks on the Arakan Yoma

range and obtained a sufficient number of points to start the surveyors afresh. On the 10th of January we left Myaing, Lieutenant Langtry's column returning to Chindwe to explore and survey in the country south of that place and east of the Arakan Yomas.

Mr. Greenstreet's party accompanied them as far as Chindwe, and then returned to Paletwa by a route 15 to 20 miles south of the one it had come by. Sub-Surveyor Abdul Rahim again accompanied Mr. Greenstreet and mapped a large extent of country on the way and after the return to Paletwa to the north of that place.

Mr. Ross' party returned to Mindat-sakan by a slightly different route to the one it had come by, Captain Rigby from Mr. Greenstreet's column accompanying it. We arrived at Mindat-sakan on the 30th of January and on the 9th of February started again to explore the upper waters of the Môn river and the unmapped country to the north. Before leaving I sent instructions to Sub-Surveyor Ramsabad, on the return of No. 1 column, to join me, on our column leaving the hills in the 2nd week of March at Tilin, a Burmese village, 30 miles north of Mindat-sakan. Captain Rigby and I also wrote for permission to re-enter the hills again in March to survey what we could of the Baungshe country and the Myittha river drainage.

On the 17th February we arrived at a camp near Pulumtung (8,900 feet) on the Môn-Maw watershed; here we were delayed by bad weather for a couple of days. At Pulumtung a temporary base was formed under Lieutenant Fleming, while the remainder of the column explored the Môn and Thet valleys on our way to Twidin (Tinkring), to which place Lieutenant Fleming was to move his base along the watershed. I was fortunate during this reconnaissance to be able to climb, among other hills, a very commanding peak in the Yoma range Tai Teh Tung (8,800 feet) from which I obtained an excellent view over the Arakan hill tracts and the country our columns had traversed. In the Môn valley we had expected to meet with some resistance, but we met with none, although at one large village of 100 houses (M'chum) the men turned out with their bows and spears and threatened to obstruct our advance. On the advanced guard fixing bayonets and marching towards them, they dispersed and we heard no more of their objections to our presence. We met Lieutenant Fleming's party at Twidin and halted three days to enable us to ascend Maw Bim Tung (8,990 feet), one of the highest peaks in the neighbourhood from which I had hoped to begin the extension of my triangulation to the north over the Baungshe country. In this however I was disappointed, as owing to the dense haze little could be seen to the north.

On the 5th of March we left Twidin for Tilin, which we reached on the 10th. Here our party divided, Mr. Ross and Lieutenant Fleming with a small escort returning to Mindat-sakan by a road across the Maw, Yaw and Maung valleys, while Captain Rigby, Lieutenant Barnard and myself waited at Tilin for orders regarding the final expedition we had applied for permission to make.

Orders arrived on the 17th, and Mr. Duncan, the Political Officer who had accompanied the 1st column, was sent in political charge of our party. As the season was already advanced and the rains approaching, it was not found possible to attempt all we had hoped to do, but on this expedition we explored a considerable part of the unmapped portions of the Maw and Myittha drainages and passed through the hitherto unvisited villages of the Welaung Chins. We returned by Daidin and the Myittha river valley to Minywa which we reached on the 19th April, and the column immediately started for Pakôkku.

The total area of country mapped on the ¼ inch scale was 8,170 square miles, of which 2,000 square miles were triangulated. All three sub surveyors worked hard and, in spite of the rather rough time they had, and the difficulties of the country, did all that could be effected with the time and routes at their disposal.

The main feature of the Southern Chin country is the high mass of hills round Aisatung where the Arakan Yoma range splits into two branches on either side of the Môn river drainage. The peaks at the sources of the Môn are all over 8,000 feet elevation and run up to 9,100 feet. They give rise to the sources of the Myittha, Maw, Maung, Thet and Môn rivers on the north east, east and south sides.

Mount Victoria (10,100 feet), the highest peak in the Chin country, if not in Burma, is not on the Arakan Yoma range, but forms the culminating point of the eastern offshoot above referred to.

The best roads in the country are those leading along the summits of the Aisatung, Mount Victoria range and along the ridges of the spurs descending on either side. On the summit of the ranges the roads lead through oak, pine and rhododendron forest, alternating with open park like clearings, the grazing ground of herds of bison, the old tracks and other traces of which are to be seen every where in the higher hills. Along this range water is fairly plentiful, there being apparently a line of springs at intervals of from ½ to 4 miles apart about 500 feet below the summits. By combining several of these water sources there is no doubt a sufficiently copious water supply could be obtained for a sanitarium, when it is decided to have one in these hills.

The inhabitants of the Southern Chin hills, though obviously of the same stock, differ considerably in the different valleys. The Baungshes inhabit the upper drainage of the Myittha. The Welaung Chins those of the Rong, a southern tributary of the Myittha. The Yaw, Maung and Che valleys are inhabited by Chinbôks, while a similar but distinct people occupy the scattered villages on the west bank of the Môn. These last are easily distinguished by the curious coils of lacquered cane which worn round the waist form

with a small strip of cloth the principal clothing of the men. This strip of cloth about 1 to 2 inches wide is decidedly more modest in dimension than in effect. Captain Rigby of the Intelligence Department and Mr. Ross, I.C.S., made a thorough study of the various peoples and their politics, but I do not think they discovered any regular tribal combinations among the Chin villages such as exist among the tribes on the North-Western Frontier of India. The higher hills are very scantily populated. The inhabitants of the few hamlets are great *shikaris* and have collections of bison, sambhar, serow and boar's heads on the gables of their houses that many English sportsmen would envy.

I was much indebted to Captain Rigby for his assistance to my work and to Mr. Ross for the correct spelling of names and for the assistance he gave me by conforming the movements of the column as much as possible to survey requirements.

The following notes are from a report by Sub-Surveyor Abdul Rahim :—

Arriving at Akyab on the 19th November, Abdul Rahim reported himself to Mr. Greenstreet, who made the necessary arrangements for him and his six *khalasis* to accompany the Arakan column. On the 21st December Mr. Greenstreet's party arrived at Myaing, and as the two columns from the Pakôkku district were not expected till the first week in January, Mr. Greenstreet employed the intervening time in visiting the neighbouring Chin villages west of the Yoma range, Captain Rigby and Abdul Rahim accompanying him with a small escort, while the main body were encamped at Myaing. On the 31st December, Mr. Greenstreet and his party returned to Myaing, and on the 3rd January the 1st and 2nd columns marched in.

The three columns left Myaing on the 9th. Abdul Rahim again accompanying the 3rd column under Mr. Greenstreet. The return journey was made by the Lower Lemru Guard, the surveyor being left behind with a small escort for a few days to survey in the neighbourhood of the Seng Chaung.

On the 4th February, Abdul Rahim received a letter from Mr. Greenstreet asking him to proceed to Paletwa, and on his arrival at that place Mr. Greenstreet arranged for him to survey within the limits of the Arakan administration. He accordingly worked his way to the Kyauk Pine Daung range, where he ascended the highest summit and then down the Kaladan river and up its tributary the Pi Chaung, mapping in the eastern slopes of the range, forming the boundary between Arakan and Chittagong using the points of Mr. O'Donel's triangulation.

On the 10th April he finally arrived at Paletwa, having completed during the season 4,608 square miles of quarter inch reconnaissance work

Abdul Rahim describes the country of the Arakan hill tracts as consisting of "a series of elevated plateaus, great rolling grassy downs separated by deep valleys and intersected by parallel ranges the general direction of which is north and south . . . . . the general summits of the plateaus being 1,000 to 3,500 feet elevation." The roads were merely tracks running along the rocky beds of the rivers.

Apparently throughout the country west of the Lemru different dialects of one language are spoken, while on the east of that river to the Yomas the tribes have different languages. In religion and dress the people seem to approach the Eastern Chins, the further they are from the semi-civilized administered districts. Like the Eastern Chins they tattoo the faces of their women, and have few if any prejudices regarding what they eat. They burn their dead making the ceremony an occasion for two or three days feasting and heavy drinking. Some of the tribes erect flat tables of slabs of rock at the site of the burning, while others, after collecting in an earthen jar the remnants of bones and ashes, bury them in the village graveyards, and, instead of the stone tables, erect miniature models of houses in which food and drink are placed for the use of the departed spirit.

Marriage is arranged by the parents of each party on the man having first instigated his parents to approach those of the girl on the subject. Two wedding feasts are held, the first at the bridegroom's house and the second two days later at the bride's.

Rice is cultivated by most villages either on irrigated lands or on the hill sides in Taungyas (hill side fields); pumpkins, Indian corn, millet, pulse, cotton and tobacco are also grown by the wilder tribes. The Arakanese and Chaungthas cultivate sugarcane, vegetables and melons in addition. Each village makes its own clothes and cotton blankets. Rice and tobacco are exported, and Abdul Rahim also states that there is some trade in ivory and rhinoceros' horns.

The valleys are generally feverish for Europeans and Natives of India, but the hills are probably fairly healthy.

Extract from the Narrative Report of CAPTAIN G. P. LENOX-CONYNGHAM, *R. E., Deputy Superintendent, 1st grade, on the determination of the* LATITUDE OF MADRAS OBSERVATORY, *season 1896-97.*

The report consists mainly of extracts from notes written by Captain Burrard before giving over charge of the Astronomical Parties, with some additions having reference to the final results of the computations.

Captain Burrard says :—

"My original intention had been to observe four complete nights with the zenith telescope, and eight with the zenith sector, four of the latter by the Talcott method and

four by the sector method. But the programmes were so broken into by passing clouds, that I eventually observed for eight nights with the zenith telescope and for five with the zenith sector (sector method). Mr. Michie Smith took observations on five nights with the zenith sector on the Talcott method. The number of observations taken was :—

110 pairs, Talcott method, zenith telescope, by myself.
58 pairs, Talcott method, zenith sector, by Mr. Michie Smith.
101 double observations, sector method, zenith sector, by myself.

Description of Stations.

" I set the zenith telescope upon the same pillar that Captain Lenox-Conyngham observed from, and I built a brick pillar for the zenith sector on the prime vertical thirty feet east. This brick pillar had the usual foundation two and a half feet deep, and proved most satisfactory, remaining perfectly steady from hour to hour and from night to night: the levels of the zenith sector were not affected by movements of men in the tent.

" Captain Conyngham's pillar consisted of three solid cylindrical granite blocks, superimposed and cemented together, which were brought to India and erected by the American longitude observer in 1881, and which are mentioned in the official account of the American longitude work, as having been used at their China stations. This pillar was to all appearances of ideal construction, was situated in the most suitable position for our work, and was of just the right dimensions for our zenith telescope.

" On December 22nd, when I commenced observations, so many things were going wrong that I did not notice any particular instability of level, but on December 23rd I saw that it was very unsteady: it seemed as if the bubble would generally begin to move at the moment, when I was about to read it. Mr. Michie Smith was present and we attributed this movement to the heat from the hand lamp, whose rays are thrown on to the level at the instant of reading; on December 24th, however, we found that, though the hand lamp did have some slight effect, the chief cause of the movement was my action in rising from the observing seat after an intersection and transferring my weight from the seat to my feet. One of the new observatory tents, which have no flooring, was in use, but the pillar had been insulated with dry sand.

" Further tests showed us that this massive granite pillar was affected by every movement in the tent, and on digging for better insulation we unexpectedly discovered that, though it rose to a height of 2½ feet above the level of the ground, it only sank to a depth of a few inches below, and was without any foundation. The three granite cylinders are each a foot high, and the joints between them are easily visible above ground: the Government Astronomer had always thought, that a fourth and possibly a fifth cylinder were buried underground as a foundation, and he expressed great surprise at the discovery that the pillar consisted merely of the three visible blocks.

"The idea may occur to others, as it did to me, that the identity of the American station has possibly been mistaken. The erection however of this granite cylinder is well authenticated historically, and its centre is situated so exactly on the primary meridian of Madras, that its astronomical origin cannot for one moment be doubted. At this distance of time it is impossible to say how this unsteadiness was got rid of by the American observers, though there can be no doubt that at the time of their observations it must have been in a satisfactory condition.

"Though I stopped all movements in the tent and sat myself to observe in such a position that to read the level I had only to rise without moving my feet, the bubble almost invariably started off when I rose. I tried reading the level by reflection in a hand-mirror without rising from my seat, but this device failed as I was apt to touch the instrument. On December 25th I constructed a wooden flooring and the level then became fairly steady, though on occasions it would still move at my rise from the observing seat, and its steadiness never equalled that of the zenith sector.

"A peculiar feature of the unsteadiness was that *in the long run* the granite pillar was remarkably steady, for I had never to re-adjust the level of the instrument even from night to night. If any one went near the pillar, the level would be temporarily altered, but it would immediately recover if he went away. In fact the granite behaved much as it would have done if it had been standing on a raft floating in a pond: its general level in that case might remain unaltered for days and weeks and months, but if an observer stepped on to the raft, the pillar would incline towards him: if he moved about on the raft, the level of the pillar would alter with his movements, and it would reassume its normal position as soon as he went away: it would remain steady as long as he remained absent.

"That level unsteadiness could produce a systematic error throughout six whole nights seems hardly reasonable; yet at Madras I am inclined to think that it may have done so, because in nine cases out of ten the bubble movement at the moment of reading was towards the north: it would have been easier to decide this point if our zenith telescope had carried two levels as the American instruments do.

"This report is written before the results have been worked out, and before I know whether my final value will disagree with Captain Conyngham's or not.

" It will be interesting to see whether the construction of the flooring affected the results; I do not anticipate much effect, because from the very first I made a point of

rapidly noting the bubble's position at the very instant of rising and of recording that position only."

The results having now been computed I append a table, including three other values, *viz.*, that given in the Nautical Almanac, which was the result of a large number of observations taken in the observatory; a value determined by Downing from direct and reflex observations made by Taylor, and a value quite recently obtained by Mr. Michie Smith by solar observations with the zenith sector.

	Observer and method.	Resulting Latitudes.
1	Value in Nautical Almanac from many observations taken in observatory .	13° 4′ 8″·1
2	Downing from Taylor's observations	8″·04
3	Lenox-Conyngham with zenith telescope on unsteady pillar	8″·80
4	Burarrd with zenith telescope on unsteady pillar	8″·34
5	Burrard with zenith sector on steady pillar	7″·94
6	Michie Smith with zenith sector by Talcott method	7″·25
7	Michie Smith with zenith sector by solar observations	8″·01

Result No. 6 Mr. Michie Smith assigns but little weight to, and it may be disregarded.

Assuming therefore that the mean of 1, 2, 5 and 7 is the true value we have 13°—4′—8″·02.

Now the correction to the latitude on account of change in the readings of the level between the observations of the first and second stars of a pair—

$$= + \tfrac{1}{4} \Sigma \, (N\text{-}S)$$

If therefore N is generally larger than it should be, the correction will be too large algebraically and the resulting latitude too large. Captain Burrard says above that "the bubble movement at the moment of reading was in nine cases out of ten towards the north." That is to say, the N reading was generally too large, and would have been larger still if the reading had not been promptly taken. Now I recollect when observing at Madras that I occasionally noticed that the bubble was moving, but I failed to attribute this to its true cause, and thought that the level was sluggish, and that the bubble had not yet come to rest, and therefore waited till it did so. It is clear therefore that one would be justified in expecting Captain Burrard's result to be somewhat larger than the truth and mine considerably larger, and this is exactly what has been found. Captain Burrard's error is +0″·32, and mine +0″·78. It is interesting to note also that the mean of Captain Burrard's observations taken before he had a floor made was 0″·14 greater than the mean of those taken subsequently.

This evidence, taken together with Captain Burrard's remark as to the observed direction of motion of the bubbie, proves conclusively that the unsteadiness of the pillar did produce a systematic error in the observed value of the latitude. This result is unexpected and very difficult to understand; the practical deduction to be made is however obvious, namely, that very great care must be paid to the proper insulation of pillars, and that no faith can be put in probable errors as a test of accuracy unless all unsteadiness has been carefully guarded against. It will be noticed that among the sets of observations mentioned above, there is no satisfactory set by the Talcott method. It is very desirable that an opportunity should be taken of observing with the zenith telescope on a properly constructed pillar.

Captain Burrard then adds a discussion of the micrometer value, he says:—"Colonel Herschel's value of the zenith sector micrometer was 0″·428871, but its accuracy has never been tested by the Talcott method. It will be seen from the redeterminations in my observatory Memo Book that at Madras this value was too small: after I left Madras, further redeterminations were made by Mr. Michie Smith, and he obtained the value 0″·42987.

"The value of the zenith telescope micrometer has been determined by Captain Conyngham many times and is known more accurately than that of the sector: Captain Conyngham's original method of determination was to intersect circumpolars at elongation at known intervals of time, but this method is very liable to errors from refraction,

and he obtained his final value $0''\cdot693556$ from an exhaustive treatment of his latitude results. This year I tried a new method and after many determinations obtained the mean value $0''\cdot693404$. (An examination of the results where this value was used points to an error of $+0''\cdot000266$, so that the value should be $0''\cdot693290$.)

"I selected two stars differing by a few minutes in Right Ascension and by about one degree in declination, and intersected them in succession on the meridian without touching the telescope between the intersections. The micrometer value was deduced by comparing their known difference of declination with the micrometric measurement corrected if necessary for level: if the stars are well selected, their errors of place are likely to be systematic and not accidental, and the former class have no effect if the two stars are situated together.

"In the case of the sector value an uncertainty exists in the third place of decimals, but in the telescope value the third place is well known, and it is the fourth place that is doubtful. As these values have to be multiplied by 2,000 or 3,000 divisions, the latitude by single pairs will differ by 2" or 3" according to which value is adopted for the sector, and by $0''\cdot3$ or $0''\cdot5$ according to which value is adopted for the telescope.

"In the Indian Survey no satisfactory plan has yet been devised of dealing with the micrometer value, and our observers have never shown the same confidence in their Talcott results as the Prussians and Americans do.

"During actual field operations there is no time to spare for experiments, and these must be made in the recess or not at all. Up to date our efforts have been directed towards attaining a micrometer value, which will suit all observations and all stations: our failure has been probably due, partly to the value being affected by temperature, and partly, to its want of uniformity at different parts of the thread. Variation with temperature and want of uniformity could both be tested with a tappet and chronograph by revolving the micrometer eye-piece through 90°, and thus making the horizontal wire vertical, and by then taking star transits over the wire at every 500 divisions of the micrometer scale."

In order to reduce the amount of work thrown on the micrometer screw, three wires have now been fixed to the sliding frame, about 1,000 divisions apart, and a star will in future be intersected with that wire which lies nearest to it.

The intervals between these wires can be determined very carefully beforehand, and its value will of course be independent of any irregularity in the screw, and will also be less affected by temperature, for the sliding frame is of brass, the same material as the tube of the telescope, and should therefore expand or contract in the same ratio. The micrometer screw being of steel does not do so.

All effect of error in the adopted value of the micrometer can, as has been pointed out in previous reports, be eliminated by carefully choosing the pairs such that the sums of the additive and of the subtractive micrometer correction should be equal, but as Captain Burrard remarks:—'No one who has not had actual experience can realise the difficulty of selecting pairs to balance, and the shorter the programme the more difficult the task. In his recently published account of the Survey of South Africa, Dr. Gill contends that it is useless to observe for latitude at an ordinary station for more than one night, and recommends a return to the Walker-Herschel group system of latitudes. His conclusions are unassailable; but if his recommendations be adopted, the difficulty of finding pairs to balance over only one night's work will be so great, that unless satisfactory means be devised of dealing with the micrometer value, a return to the sector method of observing will be our ignominous but only alternative."

DRAWING OFFICE, CALCUTTA.

SECTION I.—GEOGRAPHICAL DRAWING AND COMPILATION.

Statement showing the work performed during the year 1896-97.

TITLE.	Scale.	Number of Sheets.	REMARKS.
ATLAS OF INDIA.	In. M.		
Sheets Nos. 3 N. W., 5 S. E., 8 S. E., 8 S. W., 10 S. E., 10 N. W., 10 S. W., 11 N. E., 11 N. W., 11 S. W., 12 S. E., 21 S. E., 23 N. W., 31 N. E., 31 S. E., 31 N. W., 33 S. E., 33 S. W., 36 N. E., 37 S. W., 39 S. E., 40, 40 S. W., 43, 49 N. E., 52 N. E., 53 N. W., 54, 59, S. W., 67 S. E., 68 S. W., 69 S. E., 71 N. E., 71 S. E., 72 N. E., 72 N. W., 88, 89 S. E., 90 N. W., 90 S. W., 91 S. E., 91 N. W., 91 S. W., 92 N. W., 92 S. W., 94, 106, 114, 115, 118, 119, 120, 124 N. E., 124 N. W., 127 N. W., 129 N. E., 129 S. E., and 130 N. E.	1=4	58	Additions made to railways, roads, canals and changes to boundaries.
Sheets Nos. 14 S. E., 41 N. E., 41 S. E., 41 S. W., 42 N. E., 48 S. W., 48 N. E., 58 S. E., 58 N. W., 58 S. W., 59 N. E., 62 N. E., 62 S. E., 78 N. W., 79 N. E., 79 S. E., 79 S. W., 80 N. E., 80 N. W., 80 S. W., 141 S. E., 141 S. W., 142 N. E., 142 S. E., 142 N. W., 142 S. W., 144 N. E., 144 S. E., 144 N. W., 144 S. W., 145 N. E., 145 S. E., 145 N. W., 145 S. W., 153 N. W., 153 S. W., 157 N. E., 163 S. W., 164 N. W., 164 S. W., and 165 N. W. . . .	1=4	41	Additions made to names and details for engraving.
Sheets Nos. 27A N. E., 27A S. E., 37 N. W., 65 & 78 N. W.	1=4	5	Hills brush shaded, for engraving.
GENERAL MAPS.			
India (2nd edition) (Engraved) .	1=32	6	Additions to date.
Do. (do.) (Litho.) .	1=32	6	Ditto.
Do. (shewing canals) (Photo.) .	1=32	6	Ditto.
Do. (3rd edition) (Litho). .	1=32	6	Compilation in progress.
Do. (shewing railways) (Photo.)	1=48	4	Railways to date.
Do. (Engraved)	1=128	1	Ditto.
Do. (do.) skeleton .	1=128	1	Additions to date.
Do. (do.)	1=128	1	Hills brush shaded, for engraving.
Do. (do.)	1=256	1	Railways to date.
Map of Western Himálayas (Engraved)	1=32	1	Additions to date.
Punjab	1=32	1	Completed and published.
North-Western Provinces and Oudh	1=32	1	Additions to date.
PROVINCIAL MAPS.			
Assam (Litho.) . . .	1=16	1	Additions to railways to date.
Do. (Engraved) . . .	1=16	1	Ditto to date and published.
Bengal, Bihár, Orissa and Chotá Nágpur (Litho.) .	1=16	2	Ditto ditto.

DRAWING OFFICE, CALCUTTA.

SECTION I.—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
PROVINCIAL MAPS—*contd.*	In. M.		
Bengal, Bihár, Orissa and Chotá Nágpur (Photo.) . .	1=16	2	Additions to date and published.
Bengal, Bihár, Orissa and Chotá Nágpur (Engraved) .	1=16	2	Hills brush shaded, for engraving.
Bombay Presidency (Engraved)	1=16	1	Additions to date.
Central Provinces (Litho.) .	1=16	2	Ditto ditto.
Gujarát (Engraved) . .	1=16	1	Hills brush shaded, for engraving.
Mysore and Coorg (Engraved) .	1=16	1	Completed and published.
Punjab (Litho.) (skeleton) .	1=16	4	Additions to railways.
Do. (Engraved) . . .	1=16	4	Ditto to date.
Ditto (do.) . . .	1=16	4	Compilation in progress.
Rájputána Agency (Engraved)	1=16	2	Additions to railways.
Sind (Litho.)	1=16	1	Ditto to date.
Upper Burma (2nd edition) .	1=16	2	Corrections to boundaries.
DIVISIONAL MAPS.			
Chittagong (Photo.) . .	1=8	2	Additions to date.
Chotá Nágpur (do.) . .	1=8	2	Completed and published.
Patna (do.) . .	1=8	2	Ditto ditto.
Tenasserim (do.) . .	1=8	4	Additions to date.
DISTRICT MAPS.			
ASSAM—			
Lakhimpur	1=4	1	Completed and published.
BENGAL—			
Bánkurá, Dacca, Gayá, Mánbhúm, Murshidábád, Pabná, 24-Parganás, Rájsháhí, Sáran	1=4	9	Completed and published.
Bográ, Jalpáigurí, Malda, Monghyr, Nadiá . .	1=4	5	Additions and corrections to date.
Champáran, Darbhanga .	1=4	2	Compilation in progress.
BURMA—			
Bhamo	1=8	1	Additions to date.
PUNJAB—			
Jhelum and Ráwalpindí .	1=4	2	Additions to date.
Hissár	1=4	1	Ditto ditto.
STANDARD MAPS.			
BENGAL—			
Sheets Nos. 125 and 126 .	1=1	2	Additions to date.
BOMBAY—			
Sheet No. 199	1=1	1	Additions to date.
Sheet No. 246	1=1	1	Completed and published.

DRAWING OFFICE, CALCUTTA.

SECTION I—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS—*contd.*	In. M.		
CENTRAL INDIA AND RAJPUTÁNA—			
Sheets Nos. 67, 108, 109, 118, 134, 135, 168, 211, 213, 227, 235, 238, 249, 258, 260, 278, 282, 287, 303, 307, 312, 324, 331, 378, 379, 408, 410, 411, 418, 420, 421, 441, 449, 450, 471, 472, 472, 475 and 476 .	1 = 1	38	In progress.
Sheets Nos. 121, 175, 176, 177, 201, 223, 226, 230, 255, 257, 259, 261, 262 and 264 .	1 = 1	14	Published.
Sheets Nos. (161, 162, 194, 195) in one sheet, and (159, 160, 192, 193) in one sheet . .	1 = 2	2	Ditto.
CENTRAL PROVINCES—			
Sheets Nos. 28, 35, 50, 52, 67 and 68	1 = 1	6	In progress.
Sheet No. 51 . . .	1 = 1	1	Completed and published.
MADRAS—			
Sheet No. 49	1 = 1	1	Brought up to date.
Sheets Nos. 24, 26, 27, 57, 73, 77, 107, 108, 137, 138 and 139	1 = 1	11	Additions to date.
NORTH-WEST TRANS-FRONTIER—			
Sheet No. 28 S. E. . .	1 = 4	1	Completed and published.
PUNJAB—			
Sheet No. 243	1 = 1	1	Additions to date.
UPPER BURMA—			
Sheets Nos. 306 and 358 .	1 = 1	2	Completed and published.
Sheet No. 314 . . .	1 = 1	1	In progress.
UPPER BURMA (NORTH-EAST FRONTIER SERIES)—			
Sheet No. 15 N. W. . . .	1 = 4	1	Completed and published.
Sheet No. 15 (4th edition) .	1 = 8	1	Ditto ditto.
Sheet No. 14 S. E. .	1 = 4	1	Additions to railways to date.
Parts of sheets 23 N. E. and N. W.	1 = 4	1	Additions and corrections to date.
UPPER BURMA (SOUTH-EAST FRONTIER SERIES)—			
Sheets Nos. 4 S. W. (7th edition) and 6 N. E. . .	1 = 4	2	Completed and published.
Sheets Nos. 9 and 10 . .	1 = 8	2	Ditto ditto.
Sheets Nos. 3 S. E. and 3 A N. E.	1 = 4	2	In progress.
Sheets Nos. 1 (5th edition), 4 (2nd edition), and 5 . .	1 = 8	3	Ditto.

DRAWING OFFICE, CALCUTTA.

SECTION I—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
ADMINISTRATION REPORT MAPS.	In. M.		
Assam	1=48	1	Completed and published.
Punjab	1=80	1	Ditto ditto.
Upper Burma	1=64	1	In progress.
ASSAM—			
Goálpárá	1=8	1	Completed and published.
BENGAL—			
Champáran, Darbhanga .	...	...	
Dinájpur, Jalpáigurí, Jessore .	...	...	
Khulná, Patná, Rangpur, Sáran, Sháhábád and Sonthál Parganás	1=8	11	Completed and published.
Lohárdagá	1=16	1	Ditto ditto.
CENTRAL PROVINCES—			
Bálághát	1=8	1	Completed and published.
Bastar	1=16	1	Hills, brush shaded.
Chándá	1=16	1	Completed and published.
Chhindwárá	1=8	1	Ditto ditto.
Garhját States . . .	1=16	1	Ditto ditto.
Mandlá	1=8	1	Ditto ditto.
Nimár	1=8	1	Ditto ditto.
Sambalpur	1=16	1	Ditto ditto.
Saugor	1=8	1	Hills, brush shaded.
Seoní	1=8	1	Completed and published.
Wardhá	1=8	1	Ditto ditto.
NORTH-WESTERN PROVINCES—			
Mirzápur	1=12	1	Completed and published.
Náini Tál	1=10	1	Completed and published.
PUNJAB—			
Bannu	1=8	1	Completed and published.
Gujránwála	1=8	1	Ditto ditto.
Gurdáspur	1=8	1	Ditto ditto.
Gurgáon	1=8	1	Additions and corrections to date.
Jhang	1=8	1	Completed and published.
Jullundur	1=8	1	Ditto ditto.
Kángra	1=12	1	Ditto ditto.
Karnál	1=8	1	Ditto ditto.
Lahore	1=8	1	Ditto ditto.
Ludhiána	1=8	1	Additions to date.
Pesháwar	1=8	1	Completed and published.
Ráwalpindi	1=8	1	Ditto ditto.
INDEX MAPS.			
Provincial Indexes	Various .	10	Brought up to date.
Index to the Standard Sheets of Bengal	1=52	1	Additions and corrections to date.
Index shewing the Survey Operations by the Survey of India Department in North and South Lushai Hills Districts .	1=52	2	Prepared a tracing on vellum cloth.

DRAWING OFFICE, CALCUTTA.

SECTION I—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
INDEX MAPS—*concld.*	In. M.		
Index to the Standard Sheets of Upper and Lower Burma .	1=32	2	(*a*) shewing publications of 1-inch sheets. (*b*) " scales of different surveys.
Index to the Standard Sheets of Madras	1=48	1	Additions and corrections to date.
Index to the Standard Sheets of Assam	1=48	1	Corrections to boundaries and railways.
Index to the Standard Sheets of Bombay Presidency . .	1=64	1	Additions to railways.
PLANS OF CITIES AND CANTONMENTS.			
Simla and Jutogh . . .	6=1	1	Additions to date.
Plan of Mooltan-City . .	6=1	8	Corrections.
Plan of Nusseerabad Cantonment	6=1	1	Ditto.
Plans of Kasauli, Subáthu, and Umballa Cantonments . .	12=1	3	Ditto.
Plan of the City and Environs of Ajmere	12=1	7	Ditto.
Plan of the City of Calcutta .	16=1	9	Additions and corrections.
Plan of Quetta Cantonment .	16=1	4	Ditto ditto.
Plans of Solon, Dagshái and Jutogh Cantonments . .	24=1	3	Corrections.
WORK DONE FOR OTHER DEPARTMENTS.			
MISCELLANEOUS.			
Map of Mandalay Station Yard	1=400 ft.	1	Prepared for the Consulting Engineer to the Government of India.
Ten miles radius map of Lansdowne	1=1	1	Prepared.
Map of country 12 miles around Indore	1=1	1	Ditto for Lieutenant D. H. Cameron.
Map of Patná Division (12 sets)	1=8	24	Coloured for the Famine Commission.
Map of Upper Burma . .	1=32	2	Ditto for Mr. Irwin.
Map of India	1=96	1	Inserted names and heights for the Sanitary Commissioner.
MAPS, COLOURED, ETC.			
Maps on various scales . .	...	1,997	For Surveyor-General's Office.
Ditto ditto . .	...	90	For other Departments.
TOTAL .	...	2,087	

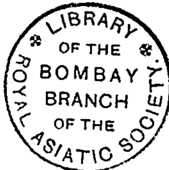
DRAWING OFFICE, CALCUTTA.

SECTION I—*concluded.*

Statement of work—concluded.

DESCRIPTION OF WORK.	Number of sheets.
Maps examined.	
Atlas sheets	87
General maps	18
Provincial maps	25
Divisional maps	2
District maps	2
Standard maps	85
Plans of Cities and Cantonments	14
Administration Report maps	31
Index maps	11
Statistical and Extra-Departmental maps	7
Miscellaneous maps	94
Originals and office copies of various maps with additions and corrections in territorial boundaries and public works	566
Tracing prints prepared for Atlas reductions	24
Tracings of roads, canals and railways from originals supplied by P. W. D.	18
Engraved proofs of Atlas sheets in various stages	171
" of General and Provincial maps, including index charts	28
" of large scale plans	2
" of Administration Report maps	40
" of Statistical maps	5
Litho. proofs of General and Provincial maps, including index charts	25
" of Atlas sheets and district maps, transferred from copper-plates	39
" of Statistical and Extra-Departmental maps	6
Photo. proofs of standard and various other maps	314
Colouring of maps for various purposes	550
Projection and examination of graticules and plotting of points	156
TOTAL	2,314

N.B.—In addition to the above, many miscellaneous jobs, such as supply of geographical data to various officials, calculation of areas, computation of graticules for the projection of the sheets of the Indian Atlas, examination of the printed catalogues of maps as to additions and corrections up to date, examination of the proof sheets of the "Survey of India Department Notes," as to the correct orthography of geographical names and various other minor works have been performed by the Examining Section.



DRAWING OFFICE, CALCUTTA.

SECTION II.—REVENUE DRAWING AND COMPILATION.

Statement showing the work performed during the year 1896-97.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS.	In. M.		
PUNJAB.			
Indus Riverain Survey.			
Sheets Nos 18, 33, 34, 35, 36, 49, 50, 51, 52 and 53 . . .	1=1	10	Proofs passed; press order given.
Sheets Nos. 24, 25, 26, 27, 40, 41, 42, 43, 45, 79, 80, (60 and 81) and 98.	1=1	13	Fair maps corrected for re-photography. Proofs passed; press order given.
Sheets Nos. 23, 46, 47, 48, 59, 68 and 99	1=1	7	Fair maps corrected and sent to press for re-photography; proofs sent out to local officials for corrections up to date.
Skeleton Maps of the Indus River showing old course.			
Sheets Nos 33, 34, 35, 36, 49, 50, 51, 52 and 53 . . .	1=1	9	Proofs passed; press order given.
District Hazára.			
Sheet No. 12	2=1	2	Fair maps corrected for reduction to half scale.
District Peshâwar.			
Sheets Nos. 51, 52, 78, 79, 105, 106, 107 and 134 . . .	1=1	8	Compiled from the old sheets with additions from tracings received from the district officials. Drawing and typing in progress.
Sheets Nos. 80 and 108 . .	1=1	2	Partly traced from the old sheets and partly added from 4-inch and 2-inch tracings received from the district officials.
NORTH-WESTERN PROVINCES AND OUDH.			
Districts Náini Tál and Garhwál			
Sheet No. 63	1=1	1	Proofs passed; press order given.
Districts Meerut and Morádábád.			
Sheet No. 31	1=1	1	Under publication.
Districts Sahåranpur, Muzaffarnagar and Meerut.			
Sheets Nos. 13 and 16 . .	1=1	2	Fair maps corrected and proofs returned to press for correction.
Sheets Nos. 6, 10, 14, 15 and 19	1=1	5	Fair maps corrected, proofs sent out to local officials for corrections up to date.
Sheet No. 18	2=1	4	Fair maps being corrected.
Districts Aligarh, Muttra and Agra.			
Sheets Nos. 23, 35 and 38 .	1=1	3	Fair maps corrected, proofs sent out to the district officers for corrections up to date.
Sheets Nos. 24, 25 and 37 .	2=1	12	Fair maps corrected and sent to press, and proofs under correction.

DRAWING OFFICE, CALCUTTA.

SECTION II.—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS—*contd.*	In. M.		
NORTH-WESTERN PROVINCES AND OUDH—*contd.*			
Districts Jaunpur, Benares and Mirzápur.			
Sheets Nos. 168 and 171 . .	1=1	2	Fair maps corrected, proofs returned to press for correction.
Sheet No. 169	1=1	1	Fair map corrected, proof sent out to the district officer for correction up to date.
Districts Gházípur, Benares and Mirzápur.			
Sheets Nos. 195, 196 and 197 .	1=1	3	Ditto ditto.
Districts Basti, Gorakhpur and Gházípur.			
Sheets Nos. 188, 189, 203, 205, 208, 209, 220 and 221 . .	1=1	8	Ditto ditto.
Portion of the Náini Tál (Kumáun Bhábar) District.			
Sheets Nos. 46 $\frac{\text{N. E.}}{2, 4}$; $\frac{\text{S. E.}}{2}$; 63 $\frac{\text{N. W.}}{1, 3, 4}$; $\frac{\text{N. E.}}{3}$; $\frac{\text{S. W.}}{1, 2, 3, 4}$; $\frac{\text{S. E.}}{1, 3, 4}$; 64 $\frac{\text{N. E.}}{1, 2, 3, 4}$; $\frac{\text{S. E.}}{2}$; 250 $\frac{\text{S. W.}}{3}$; and 251 $\frac{\text{N. W.}}{1, 2, 3, 4}$; $\frac{\text{S. W.}}{1, 2, 3, 4}$; $\frac{\text{S. E.}}{1, 3}$ . . .	4=1	30	Fair maps corrected, proofs sent out to the district officer for correction up to date.
District Pilibhit.			
Sheets Nos. 1 to 12 . .	1=1	12	Additions and corrections made to boundaries, roads, etc.
District Agra.			
Sheets Nos. 1 to 9 . . .	1=1	9	Ditto ditto.
District Budáun.			
Sheets Nos. 33, 34, 50, 51, 52, 67, 68, 69, 70, 84 and 85 . .	1=1	11	Ditto ditto.
Districts Muzaffarnagar, Meerut and Bulandshahr.			
Sheets Nos. 5, 6, 7, 8, 17, 18, 19, 30, 31 and 32 . . .	1=1	10	Ditto ditto.
OUDH.			
Sheet No. 136 . . .	1=1	1	Printed map touched up, corrected and sent to press for reproduction.
Sheets Nos. 122, 123, 136, 137, 138, 139, 150, 151 and 152 .	1=1	9	Additions and corrections made to roads and boundaries.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS—*contd.*			
BENGAL.	In. M.		
District Darjeeling (including British portion of Sikkim).			
Sheets Nos. 269 and 270 . .	2=1	8	Drawn for reduction to scale 1-inch to a mile (2nd edition). Proof of the former sent to press for correction and of the latter in hand.
Districts Darjeeling and Jalpáiguri.			
Sheet No. 294	1=1	1	Proof passed; press order given.
District Hooghly.			
Sheets Nos. 4, 6 and 8 . .	1=1	3	Additions and corrections made to roads and boundaries.
District Dinájpur.			
Sheets Nos. 9, 10, 11, 12 and 13.	4=1	5	Ditto ditto.
District Malda.			
Sheets Nos. 1 to 8 . . .	1=1	8	Ditto ditto.
District Rájsháhi.			
Sheets Nos. 2, 3, 5 and 6 . .	1=1	4	Ditto ditto.
District Mymensingh.			
Sheets Nos. 347, 348 and 389 .	1=1	3	Proofs examined and corrected up to date.
Sheet No. 391	1=1	1	Proof passed; press order given.
BOMBAY.			
Sheets Nos. 161, 166, 243, 302, 327, 329 and 337 . . .	1=1	7	Proofs passed; press order given.
Sheets Nos. 164, 183, 192, 201 and 301	1=1	5	Proofs examined and sent to press for correction.
Sheets Nos. 195, 206, 231 and 232 (in 4 sections each) . .	2=1	16	Fair maps corrected and sent to press for reduction by photography to scale 1-inch=1 mile for replenishing stock.
Sheets Nos. 328, 349, 350 and 351 (in 4 sections each) . .	2=1	16	Fair maps examined with field sections, corrected and sent to press for reduction by photography to scale 1-inch=1 mile.
Sheets Nos. 208, 209, 210, 243 and 244	1=1	5	Additions and corrections made to roads and boundaries.
LOWER BURMA.			
Sheets Nos. 181, 182, 184, 281 and 284	1=1	5	Proofs passed; press order given.
Sheet No. 179	1=1	1	Proofs sent to officials for correction.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS—*concld.*	In. M.		
LOWER BURMA—contd.			
Districts Amherst and Thatón.			
Sheets Nos. 420, 425, 426, 427, 428 and 479	1=1	6	Proofs passed; press order given.
Sheet No. 374 (in 4 sections) .	2=1	4	Fair maps corrected and sent to press for reduction to scale 1-inch=1 mile.
Sheets Nos. 421, 422, 371, 376 and 377 (in 4 sections each) .	2=1	20	Fair maps examined with 16-inch plans, corrected and sent to press for reduction to 1-inch scale.
District Tavoy.			
Sheets Nos. 486, 487, 488 and 489	2=1	14	Compiled from 16-inch plans; drawing and typing in progress.
UPPER BURMA.			
District Minbu.			
Sheet No. 126	1=1	1	Proofs passed; press order given.
Sheets Nos. 128 and 129 . .	1=1	2	Proofs examined and returned to press for correction.
Sheets Nos. 89, 90, 127, 130, 174 and 175	1=1	6	Proofs under examination.
PARGANÁ MAPS.			
BENGAL.			
District Gayá.			
Sheets Nos. 3, 8, 13, 14, 15, 16, 17, 18, 19, 21, 22 and 23 .	1=1	12	Proofs passed; press order given.
District Monghyr.			
Sheets Nos. 7 and 14 . .	1=1	2	Printed maps touched up, corrected and sent to press for reproduction.
District Sháhábád.			
Sheets Nos. 13 and 14 . .	1=1	2	Proofs passed; press order given.
District Sáran.			
Sheets Nos. 15 and 19 . .	1=1	2	Ditto ditto.
District Purnea.			
Sheets Nos. 11, 12, 14, 15, 17 and 18	1=1	6	Additions and corrections made to roads and boundaries.
District Backergunge.			
Main Circuits Nos. 7 and 8 .	1=1	2	Printed maps touched up, corrected and sent to press for reproduction; proofs passed; press order given.
District Mánbhúm.			
Main Circuits Nos. 5, (6, 7 and 10), 9 and 14	1=1	4	Ditto ditto.
District Mymensingh.			
Main Circuits Nos. (17 and 13) .	1=1	1	Ditto ditto.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
PARGANA MAPS—*concld.*	In. M.		
BENGAL—*concld.*			
District Dacca.			
Main Circuits Nos. 7 and 8	1=1	2	Printed maps touched up, corrected and sent to press for reproduction; proofs passed; press order given.
District Nadiá.			
Sheet No. 5	1=1	1	Ditto ditto.
Sheets Nos. 1, 2, 4 and 6	1=1	4	Additions and corrections made to roads, boundaries, etc.
District Bográ.			
Sheets Nos. 1 to 8	1=1	8	Ditto ditto.
District Khulná.			
Sheets Nos. 1 to 7	1=1	7	Ditto ditto.
District 24-Parganás.			
Dihi Panchánogram.			
Grand division 1, Sub-division 3	99 ft.=1 inch.	1	Printed maps touched up, corrected and sent to press for reproduction; proofs passed; press order given.
Grand division 2, Sub-division 5 Sec. ii		1	
Grand division 3, Sub-division 13, Sub-division 23 Sec. ii		2	
Grand division 6, Sub-division Q 1st, Q 2nd		2	
Grand division 6, Sub-division M, Sec. 1		1	
Grand division 6, Sub-division A		1	
CENTRAL PROVINCES.			
District Chhindwárá.			
Sheets Nos. 1 to 12	1=1	12	Corrected to date from tracings received from the district officials.
ASSAM.			
District Sibságar.			
Sheet No. 6	1=1	1	Corrected to date; proofs passed; press order given.
DISTRICT MAPS.			
PUNJAB.			
Jhang	1=2	4	Additions and corrections made to roads, boundaries, etc.
Hissár	1=4	1	Corrected; proofs passed; press order given.
Siálkot (Skeleton)	1=2	1	Examined and sent to press for reduction to half scale.
NORTH-WESTERN PROVINCES AND OUDH.			
Garhwál	1=2	6	Proofs passed; press order given.
Bahraich	1=4	1	Ditto ditto.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
	In. M.		
DISTRICT MAPS—*concld.*			
CENTRAL PROVINCES.			
Nágpur and Wardhá . .	1=2	4	Proofs passed ; press order given.
Saugor	1=2	6	Additions and corrctions made to boundaries and interior details from the 16-inch scale tracings received from the Settlement Officer.
PLANS OF CITIES AND CANTONMENTS.			
Dhárwár	8=1	2	Proof passed ; press order given.
Hubli	8=1	2	Fair map corrected and sent to press for reproduction.
Bareilly (shewing the British position and the Military operations in 1857-58) . .	4=1	1	Drawn; proof passed, press order given on 2-inch scale.
Cawnpore	12=1	9	Corrected to date and sent to press for reproduction.
Calcutta	6=1	2	Proofs passed and sent to press for correction.
Calcutta	3=1	1	Proof passed and press order given.
Calcutta $\frac{G}{2, 3}$; $\frac{H}{4, 5, 6}$; $\frac{L}{1, 2, 3, 4}$; $\frac{M}{2, 10, 12, 15}$; $\frac{N}{1, 8 \text{ and } 11 \text{ to } 20}$; $\frac{O}{1, 2, 3, 13 \text{ to } 16}$; $\frac{O}{18 \text{ to } 21}$; $\frac{Q}{3 \text{ to } 22}$; $\frac{P}{11, 15}$ and $\frac{R}{23}$.	1=50 feet	65	Reprints ordered.
Moulmein Town (in 69 sheets) .	1=50 feet	40	Proofs passed ; press order given.
Ditto ditto .	ditto	29	Fair maps corrected and sent to press for reproduction.
Cantonment of Moulmein .	1=200 feet	1	Redrawn ; sent to press for reproduction.
MISCELLANEOUS MAPS.			
Calcutta and Suburbs (in 4 sections)	2=1	4	Proofs passed ; press order given.
Calcutta, country 15 miles around	1=1	1	Drawn ; sent to press for reproduction, ; proof passed ; press order given.
TRIANGULATION CHARTS.			
Half degree sheets, Nos. 1, 7, 8 and 9 (in 2 sections each) of Gujarát Survey . . .	1=2	8	Proofs passed ; press order given.
Degree sheets, Nos. 10 and 14 (in 8 sections each) ditto .	1=1	16	Fair maps corrected and sent to press for reduction to ½-inch scale.
INDEX MAPS.			
For Administration Report .	Various.	6	Drawn and sent to press.
Ditto ditto . .	ditto	11	Corrected to 1897 and sent to press.
TRACINGS (ON CLOTH).			
Tracings of Sheets . . .	,,	39	These plans and tracings have been prepared for Government officials and other departments.
Village plans	,,	339	
MAPS COLOURED.			
Maps on various scales . .	...	140	For office use.
Ditto ditto . .	...	11,161	Colouring examined for stock in M. R. I. O.

DRAWING OFFICE, CALCUTTA.

SECTION II—*concluded.*

Statement of work—concluded.

Description of Work.	Remarks.
Computations examined.	
District Tippera, Season 1890-91.	
" Chittagong " 1888-89.	
" Kyauksè " 1889-90.	
" Jalpáigurí " 1889-90.	
" Sibságar " 1889-90.	
" Akyab " 1884-85.	
" Balasore " 1893-94.	
" Bhandára " 1889-90.	
" Ráipur " 1893-94.	
" Narsinghpur " 1886-88.	
" Henzada " 1889-90.	
Traverse data, etc., supplied.	
District Sagaing, along Lower Chindwin, (18 pages) .	To O. C. No. 3 Party.
" Mandalay, along unsurveyed portion (36 pages)	Ditto ditto.
" Kheri, along Nepál Territory, (7 pages) .	To O. C. No. 2 Party.
" Pilibhít, along Nepál Territory . . .	Ditto Ditto.
" Basti, along District Gorakhpur, (23 pages) .	To O. C. No. 8 Party.
" Tippera along Bay of Bengal with charts (12 pages)	To O. C. Noákhálí Detachment.
Eastern Boundary of Dakhin Sháhbázpur (8 pages) .	Ditto ditto.
Backergunge villages (40 pages)	To Collector.
Village Traverses (72 pages) . . .	To public officers.
Triangulation data of District Násik . . .	To Superintendent, Bombay Revenue Survey.
" " Buxa Cantonment . .	To Executive Engineer, Military Works Division.
" " District Seoní . . .	To Superintendent, Forest Surveys.
Field Area Statements of District Minbu (21 pages) .	To Superintendent, Land Records and Agriculture.
" " District Prome (14 pages) .	To Deputy Commissioner.
" " District Amherst (102 pages)	Ditto ditto.
" " District Akyab (248 pages)	Ditto ditto.
" " District Purí (23 pages) .	To Settlement Officer.
Values and description of all G. T. S. Stations in District Nadiá (10 pages)	To Collector.
Calculated latitudes and longitudes of Revenue Survey points in Districts Akyab, Jalpáigurí, Bhandára, Seoní and Bhurtpore State. Prepared a scale of contours 25 feet apart on 4-inches to the mile for Captain Hodgson. Calculated two tables for reducing slopes to horizontal values. Calculated areas by Tahsils and Parganás of standard sheets Nos. 6, 13, 16, 31, 38, 169, 171 and 209, North-Western Provinces; sheets Nos. 294 and 337, Bengal; sheets Nos. 164, 166, 206, 327, 347, 349 and 351, Bombay; and sheet No. 319 Punjab. Calculated the area of the City and Environs of Dhárwár and revised the area of District Hoshiárpur by summation of villages. Adjusted the areas of Districts Cuttack and Balasore according to revised boundaries. Plotted Kála Chitta Pahár, District Ráwalpindi, on 4-inch scale. Prepared and submitted a report on the character, scale and date of survey of all the districts in the Lower Provinces of the Bengal Presidency since the commencement of Revenue Survey Operations in 1830	

Description of Work.	Remarks.
Traverse data, etc., supplied—concld for the Bengal Government. Prepared a statement showing area, cost and season of cadastral survey of the districts in North-Western Provinces from 1872-73 for the Board of Revenue, North-Western Provinces. Computation and plotting of a group of Murshidábád villages for preparation of a congregated 4-inch village map for the Collector. Inserted traverse stations on the 16-inch cadastral maps of District Garhwál with extracts from traverse volumes for relaying of boundaries for the Deputy Commissioner. Calculated the area of the estates of the Mahárájá of Benares by summation of villages. Supplied the Officer in Charge, No. 2 Party, with the numbers of villages of the old 4-inch survey of Districts Gonda and Bahraich. Prepared statements for the General Report, checked annual statements received from executives, and did a large amount of miscellaneous work.	

DRAWING OFFICE, CALCUTTA.

SECTION III.—CADASTRAL.

State of publication of Cadastral Maps on the 30th September 1897.

DISTRICTS.	NUMBER OF SHEETS.							REMARKS.
	MAPS RECEIVED.			MAPS PUBLISHED.				
	Up to 30th September 1896.	Added during past 12 months.	Total up to 30th September 1897.	Up to 30th September 1896.	By Surveyor General's Office during past 12 months.	Total to 30th September 1897.	Remaining to be published.	
North-Western Provinces.								(a) These figures are liable to alteration until publication has been completed.
Agra	2,942	...	2,942	2,942	...	2,942	...	
Azamgarh	930	...	930	930	...	930	...	
Ballia	1,601	...	1,601	1,601	...	1,601	...	
Bánda	3,317	...	3,317	3,317	...	3,317	...	
Basti	5,571	...	5,571	5,571	...	5,571	...	
Benares	2,052	...	2,052	2,052	...	2,052	...	
Bijnor	31	...	31	31	...	31	...	
Dehra Dún	701	...	701	701	...	701	...	
Fyzábád	14	...	14	14	...	14	...	
Garhwál	9,100	...	9,100	2,255	2,906	5,161	3,939	
Gházipur	4,021	...	4,021	4,021	...	4,021		
Gorakhpur	8,615	...	8,615	8,615	...	8,615	...	
Hamírpur	2,926	...	2,926	2,926	...	2,926	...	
Jaunpur	3,583	...	3,583	3,583	...	3,583	...	
Jhánsi	1,661	...	1,661	1,661	...	1,661	...	
Kumáun (Bhábar)	332	...	332	332	...	332	...	
Morádábád and Tarái	4,023	...	4,023	4,023	...	4,023	...	
Muttra	1,658	...	1,658	1,658	...	1,658	...	
Mirzápur	3,794	...	3,794	3,794	...	3,794	...	
Rámpur Estate	1,356	...	1,356	1,356	...	1,356	...	
Tarái	862	...	862	862	...	862	...	
TOTALS	59,090	...	59,090	52,245	2,906	55,151	3,939	
Burma.								
Akyab	2,785	...	2,785	2,785	...	2,785	...	
Amherst	3,664	...	3,664	3,664	...	3,664	...	
Bassein	3,437	...	3,437	3,437	...	3,437	...	
Hanthawaddy and Pegu	4,601	...	4,601	4,601	...	4,601	...	
Henzada	1,391	...	1,391	1,391	...	1,391	...	
Katha	...	56	56(a)	...	...	...	56	
Kyauksè	801	...	801	801	...	801	...	
Mandalay	781	...	781	781	...	781	...	
Meiktila	722	1,139	1,861(a)	722	647	1,369	492	
Mergui	1,071	...	1,071	1,071	...	1,071	...	
Minbu	1,384	63	1,447(a)	724	723	1,447	...	
Prome	847	...	847	847	...	847	...	
Rangoon Town and Index	20	...	20	20	...	20	...	
Sagaing	2,286	...	2,286	1,487	227	1,714	572	
Tavoy	763	...	763	763	...	763	...	
Tharrawaddy	1,363	...	1,363	1,363	...	1,363	...	
Thatôn	1,048	152	1,200(a)	497	609	1,106	94	Exclusive of 13 sheets of Thatôn (Municipality) reprinted.
Thôngwa	3,749	...	3,749	3,749	...	3,749	...	
TOTALS	30,713	1,410	32,123	28,703	2,206	30,909	1,214	
Bengal and Orissa.								
Backergunge	...	261	261(a)	...	261	261 (b)	...	Published by order of the Board of Revenue, Lower Provinces.
Cuttack Town	86	...	86	86	...	86	...	
Muzaffarpur	1	...	1	1	...	1	...	
Patná and Gayá	3,054	...	3,054	3,054	...	3,054	...	
Purí (Khurda Estate)	4,565	...	4,565	4,565	...	4,565	...	
Sháhábád	4,924	...	4,924	4,924	...	4,924	...	
TOTALS	12,630	261	12,891	12,630	261	12,891	...	
Assam.								
Cachar	...	191	191(a)	...	120	120	71	
Darrang	1,074	...	1,074	1,074	...	1,074	...	
Kámrúp	2,218	...	2,218	2,210	...	2,210	8	Exclusive of 3 sheets reprinted.
Lakhimpur	346	...	346	346	...	346	...	
Nowgong	1,277	...	1,277	1,277	...	1,277	...	
Sibságar	2,050	...	2,050	2,042	...	2,042	8	Exclusive of 6 sheets reprinted.
Sylhet	213	...	213	168	...	168	45	
Sylhet (Jaintia)	651	...	651	651	...	651	...	
TOTALS	7,829	191	8,020	7,768	120	7,888	132	
Central Provinces.								
Ráipur	43	...	43	43	...	43	...	
TOTALS	43	...	43	43	...	43	...	
GRAND TOTALS	110,305	1,862	112,167	101,389	5,493	106,882	5,285	

Abstract of work performed during 1896-97.

PROVINCES.	NUMBER OF SHEETS.				REMARKS.
	Examined and rendered suitable for photo-zincography.	Traced and examined for Zincography.	Proof sheets examined previous to press order.	Coloured and subsequently examined.	
North-West Provinces	2,710	725	3,277	...	Scale 32-inches=1 Mile.
Burma	2,024	690	2,049	...	Do. 16 " =1 "
Bengal	137	125	270	...	Do. 16 " =1 "
Assam	159	41	141	...	Do. 16 " =1 "
TOTALS	5,030	1,581	5,737	...	

DRAWING OFFICE, CALCUTTA.

SECTON IV.—BENGAL PROVINCIAL.

Statement showing progress of 2-inch mapping during 1896-97.

PROVINCES.	Total number of sheets.	Graticules projected.	Stations plotted.	Details reduced by pentagraph to 2-inch scale.	Names of villages, streams, etc., typed.	Outlining completed.	Footnotes, margins, etc., completed.	Examined.	Finally examined	Sent to Photographic office for reduction to 1-inch scale.	Proofs examined.	Final press order given.
ORISSA.												
Previously reported	124	100	87	85	80	80	58	80	58	44	28	...
Completed during year including Khurdá	...	24	34	29	34	34	56	34	56	44	60	12
TOTAL .	124	124	121	114	114	114	114	114	114	88	88	12
BIHÁR.												
Previously reported	116	52	41	13	12	12	...	...	...	...	...	...
Completed during the year . .	...	15	18	20	16	12	...	...	...	...	...	...
TOTAL .	116	67	59	33	28	24	...	...	...	...	...	...

ENGRAVING OFFICE, CALCUTTA.

Statement showing the work performed during the year 1896-97.

Title of Map.	Number of plates.	Outline square inches.	Number of letters cut.	Hills, sand, lakes, square inches.	Remarks.
Atlas of India.					
Scale 1 inch = 4 miles.					
Quarter sheets, new, completed .	6	8	2,860	54	
Ditto in progress .	50	878	69,571	506	
Additions and corrections to published quarter sheets . .	93	777	71,047	206	
Ditto ditto full sheets	19	131	18,293	291	
New quarter sheets projected, etc.	35	...	2,802	...	
General Maps.					
On various scales . . .	5	104	19,062	...	
Provincial Maps.					
On scale 1 inch=16 miles and 32 miles	27	1,076	36,924	260	
On various scales for Administration Reports . . .	2	...	680	...	
District Maps.					
On various scales for Administration reports . . .	37	325	24,657	233	
Index maps	3	...	1,571	...	
Plans	4	45	949	33	
Charts	3	33	5,800	5	
Miscellaneous subjects . .	65	7	51,994	...	
Total .	349	3,384	306,210	1,588	

Copper-plate Printing.

Impressions taken	20,240
Proofs pulled	493
Transfers pulled	517
Total .	21,250

Steel Facing.

Double elephant plates,	steel faced	19
Ditto	" removed	14
Quarter sheets	" faced	104
Ditto	" removed	40
Miscellaneous plates	" faced	26
Ditto	" removed	18
	Total	221

PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE, CALCUTTA.

Extract from the Narrative Report of MR. T. A. POPE, *Assistant Surveyor-General, Season 1896-97.*

OUTTURN.—The outturn of work for the year is somewhat over the average of the past few years. A considerably larger number of subjects was dealt with than usual. The actual amount of work done by the presses, as measured by the number of pulls, is practically the same as last year, though the final number of printed copies is less. Full details of the outturn in each section will be found in the appended statements.

ORIGINAL SUBJECTS.—The number of original subjects received for reproduction and either completed or partially so during the year was 7,880, or 860 more than in the previous year. This number is considerably in excess of any year in the past. The increase is entirely under the head of departmental and cadastral maps, the number of subjects received from other departments showing a decrease as compared with last year, though well up to the average. The number of subjects lithographed was 612, of which 56 were departmental and 556 extra-departmental, against 46 departmental and 536 extra-departmental last year. The remaining 7,268 were either reproduced by various photographic processes or zincographed, and include 993 departmental, 5,634 cadastral, and 641 extra-departmental. The actual number of maps, etc., received during the year was 7,496, of which 930 were departmental, 5,666 cadastral, and 900 extra-departmental. The number completed in all respects was 7,361, of which 609 were departmental, 5,518 cadastral, and 1,234 extra-departmental.

LITHOGRAPHIC DRAWING SECTION.—This section remained under the charge of Mr. S. M. Coard, of the Engraving Office, until the 31st March 1897, when he was relieved by Mr. R. Fogarty, who arrived from England under an agreement with the Secretary of State to assume the post of Head Assistant, Litho Branch. Mr. Fogarty rapidly mastered the rather complicated details of the work of his branch, for which his previous training and experience have specially fitted him. He is in every respect well qualified for the post, and has shown tact and judgment in his management of the staff of native draftsmen and others under his supervision. The total number of new drawings, or additions, etc., made to maps on stone during the year was 515, of which 26 were departmental and 489 extra-departmental.

LITHOGRAPHIC PRINTING SECTION.—The number of subjects printed from stone was 612, or 118 more than last year; of these, 56 were departmental and 556 extra-departmental, against 38 departmental and 458 extra-departmental last year. The number of pulls from stone was 572,719, of which 45,505 were departmental and 527,214 extra-departmental, while the number of copies was 555,525, of which 45,120 were departmental and 510,405 extra-departmental. Sergeant Vandyke, R.E., held charge of the section, under Mr. Fogarty's supervision, throughout the year, and has continued to show himself a very steady and efficient assistant.

ZINC PRINTING SECTION (Normal).—The number of zinc plates printed during the year was 1,104, of which 509 were departmental and 595 extra-departmental. The number of pulls was 148,003, of which 87,818 were departmental and 60,185 extra-departmental, and of complete copies 175,254, of which 84,957 were departmental and 90,297 extra-departmental. The figures for last year were, number of plates printed 1,140 (355 departmental, 785 extra-departmental); number of pulls 178,919 (76,445 departmental, 102,474 extra-departmental); number of completed copies 249,171 (74,071 departmental, 175,100 extra-departmental). Mr. E. A. LeFranc continued in charge of the section and managed the work very efficiently.

ZINC PRINTING SECTION (Cadastral).—During the year, plates of cadastral maps of the Bengal, North-Western Provinces, Assam and Burma surveys were printed off to the number of 5,645, the number of pulls being 133,223, and of copies of complete villages, 122,293. Last year, 4,921 plates were printed, the pulls being 121,584, and complete copies 111,430. The figures show a large increase of work during the year under report. Mr. J. B. Mackenzie held charge throughout the year and gave entire satisfaction.

TYPE PRINTING SECTION.—The work in this section shows a decrease during the year, owing to the smaller demands from the head-quarters offices and field parties for departmental forms, the printing of which forms the greater part of the work of the press. There was a large outturn in the preceding year, which supplied all requirements in advance for some time. The number of pages or items set up was 10,054, or 1,861 less than last year; the number of pulls was 931,543 (340,014 less than last year), and of copies 529,664 (139,131 less than last year). Mr. DePyvah, the Head Type Printer, continued to perform his duties to my satisfaction.

NEGATIVE SECTION.—The number of negatives taken during the year was 6,272, or 316 more than in the previous year. Of these, 1,375 were of departmental maps, etc., 4,056 cadastral, maps, and 841 extra-departmental subjects. Last year the figures were, 968 departmental, 3,696 cadastral, and 1,292 extra-departmental, or a total of 5,956. No alteration was made in the processes employed, and there is nothing special to record. Mr. H. Haward, Head Assistant, Photographic Branch, was in charge of the section throughout the year, and managed it to my entire satisfaction. Arrangements were made at the close of the year to increase the supervising power and responsibility exercised by

SPECIMEN OF ENAMELINE PROCESS.

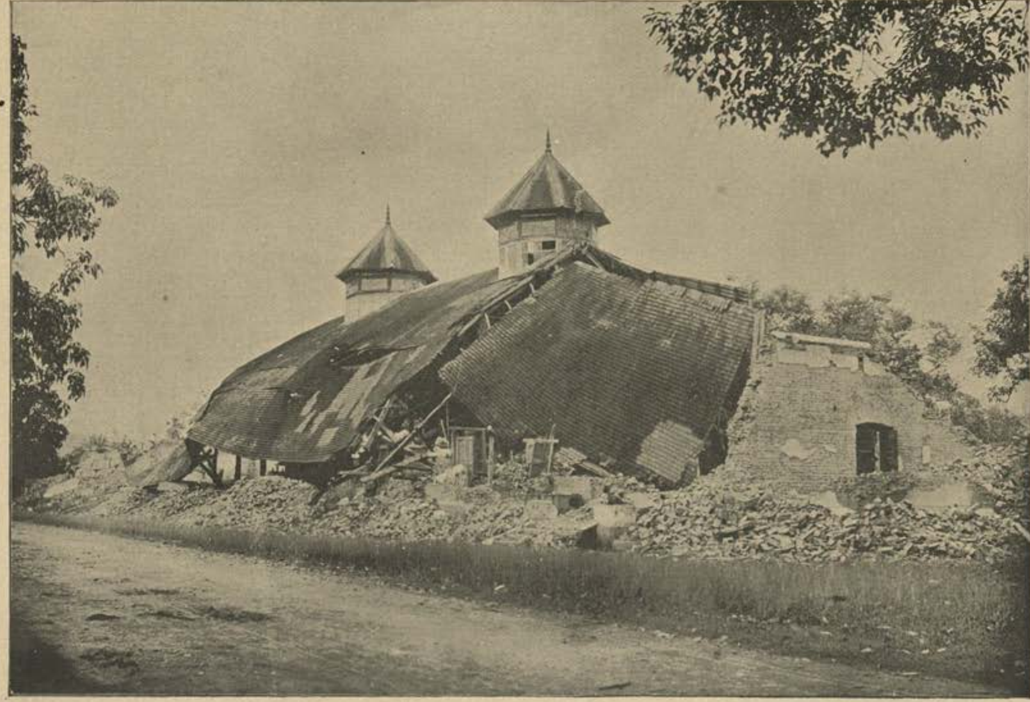


Photo-Block.

Survey of India Offices, Calcutta, February 1898.

COMMISSIONER'S CUTCHERRY, GAUHATI.

After the Earthquake of 12th June 1897.

Mr. Haward, by placing all the photographic sections under him, so as to assimilate his status in the office to that of the Head Assistant, Litho Branch. The effect of this change will be reported on next year.

PHOTO-TRANSFER PRINTING SECTION.—There is a slight falling off in the number of photo-transfer prints made during the year, which was 5,794, against 5,860 last year. Of these, 1,191 were departmental, 3,971 cadastral, and 632 extra-departmental. Last year the figures were, 1,020 departmental, 3,696 cadastral, and 1,144 extra-departmental. Mr. Harrold continued in charge and performed his duties efficiently. No changes were found necessary in the processes employed.

SILVER PRINTING SECTION.—In this section, 3,267 cyanotype or blue prints were made during the year, being 725 in excess of last year. The number of silver prints was 527, or 173 less than last year. Mr. C. J. Meade continued in charge of the section.

HELIOGRAVURE SECTION.—There is again a large increase of printing work to be recorded in this section, though the number of plates photo-etched was slightly less than in the previous year, *viz.*, 131, as against 144. The number of prints made in the copperplate machine and presses was 72,246, or 15,858 in excess of last year,—a result only attained by keeping the printing staff working at high pressure throughout the year. The number of hand-engraved plates photo-electrotyped was thirteen, or four less than last year.

The Enameline Process.—It is believed that the strain on the copperplate presses will be relieved to some extent by the introduction of the "Enameline" half-tone photo-block process, to which reference was made in the Annual Report for 1894-95. Mr. Turner, Photo-engraver, has spent considerable time during the latter part of the year in experimenting upon this process, with results which warrant the belief that, for the less fine kinds of works, it will answer as well as the photogravure process, while it has the great advantage that the blocks can be printed easily and with great speed in the type machine. The following is a description of the process as it has been worked out by Mr. Turner.

The Negative.—A reversed negative is required, and it must be taken through a ruled glass screen, as described for other photo-block processes in previous annual reports. Wet collodion plates have been used hitherto and have proved quite satisfactory, but trials made on Ilford special process plates show that these are more suitable and convenient, and a supply of them has been indented for. The quality of the finished block depends almost entirely on the quality of the negative, and this is regulated by the distance of the screen from the sensitive plate, the size and shape of the stop used in the lens, the quality of the light and the nature of the subject under reproduction. Given a suitable negative the other stages of the process present but little difficulty. For half-tone subjects the negative should have good contrasts and be dense in the high lights, but not sufficiently so to block up the grain of the ruled screen.

The Copperplate.—Electro-deposited copper has been used up to the present, and has proved useful and convenient for the purposes for which we have so far used the process. If it should come into more extended use in the future, as is now certain, the ordinary commercial copperplates, as used in Europe, would in some respects be more suitable. With improved arrangements for cutting and mounting the plate a much thicker plate than has been used would be an advantage. To prepare the plate for coating, it must first be thoroughly cleaned by rubbing it with a mixture of chalk made into a paste with equal parts of liquor ammonia and water, applied with a pad of cotton wool. It is then washed well under a stream of water and flooded with a dilute solution of nitric acid (about 1 in 40) and again washed. It is now, while still wet, ready for coating with the sensitizing solution, which is made up as follows:—

Fish glue (Lepage's clarified)	1¼	ounces.
Isinglass	20	grains.
Bichromate of ammonia	120	"
Water	4	ounces.

The bichromate is first dissolved in the water, and the isinglass added; this, after a few minute's soaking, is dissolved by the application of a gentle heat. The fish glue is next added, and the whole brought into solution by stirring with a glass rod. It is then filtered through four thicknesses of muslin and is ready for use. The solution will keep for a considerable time and seems to improve somewhat after a few days' standing. Mr. Turner has used it continuously for over ten days, but cannot with his present experience say to what limit it may safely be kept.

The moist copperplate is now placed in a "whirler", or any arrangement by which it can be rapidly revolved, face downwards, over a gas stove or other convenient source of heat. The sensitizing solution is poured over the plate, driving the moisture in front of it, and drained off from the right hand lower corner. It is then flowed over a second time and the surplus drained back into the stock solution. The plate is held face downwards over a heated surface, and rapidly revolved until it is dry. This gives a perfectly even coating of the sensitizing solution, and only occupies a few minutes. It is now ready for printing, which should be done while the plate is still warm.

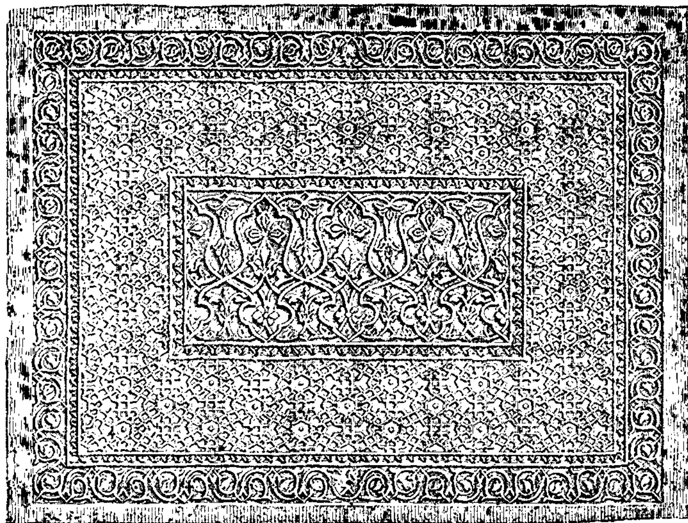
Printing, developing and enamelling.—Perfect contact between the copperplate and the negative is a *sine quâ non* in this process, and this can only be obtained by well distributed and great pressure in the printing frame. The copperplate must be perfectly

level, and care must be taken that there is no dust between the plate and negative. Special printing frames are made for this purpose, but so far only temporary arrangements have been used to secure this object. The exposure varies from four to eight minutes, approximately, in the sun. After removal from the printing frame the plate is washed for a few minutes in cold water and then placed in a dish containing a solution of an aniline dye (preferably methyl violet). This renders the image visible, and it can now be judged whether the exposure and the contact between the negative and plate are right. The plate is then rinsed well in cold water, dried off with spirits of wine, and is ready for burning, which gives to the delicate, aniline-dyed gelatine image the properties of an enamel, from which the name of the process is derived.

The copperplate is placed in a suitable holder over a Bunsen gas stove, face upwards, and heated gradually from the back of the plate. The first effect of the heat is to volatilize the dye and so cause the image to disappear. The copper then tarnishes in the lights to a reddish brown, leaving the shadows of the image light. By further heating the plate the gelatine image turns gradually to a rich brown colour, while the surface of the copperplate becomes of a silver grey tint. The plate must now be removed and allowed to cool.

Etching the plate.—This operation is performed in a strong solution of perchloride of iron, which may be of a strength of 45 Baume. With a good image, well burnt in, it can be etched the full printing depth without any danger of under-biting, and will stand from 30 to 45 minutes in the etching solution, which should give a good printing plate without any necessity for re-biting. The plate should not be rocked during the etching, but can be taken out of the bath at intervals of five or ten minutes and washed under a tap to enable the progress of the etching to be examined. The depth to which the etching can be carried is purely a matter of judgment, but in this process far greater latitude is admissible than in any of the numerous others which have been tried in the Office. The plate, after it is etched sufficiently deep, is simply washed in water, cut to size, and mounted type-high.

At the close of the year under report the process had hardly emerged from the experimental stage, but since that time considerable demands for line and half-tone blocks have been received, and we have been able to use it successfully in complying with them, and there is now no doubt that it will form a permanent and most useful addition to the processes employed in the office, besides relieving the strain on the copper plate printing presses. The illustration facing this page is a fair example of the results obtained, and the block printed below illustrates the adaptation of the process to line subjects.



Mr. A.W. Turner has been in charge of the section throughout the year. He is entitled to much credit for the skill with which he has worked out the Enameline process, and for the care and attention he has bestowed upon the photogravure and other important work carried on in the section.

Machinery.—No prolonged stoppage occurred to the machinery during the year, and all worked well and smoothly. Inconvenience was again felt for want of water whenever the boiler had to be cleaned, and though no steps have yet been taken to procure a

second boiler, this should not be delayed much longer, as in the event of a breakdown the delay to the work would be serious.

A new double demy Express litho. and zinco. printing machine, by Messrs. Furnival & Co. of Reddish has been indented for, the necessity for which was explained in paragraph 529 of the annual report for last year. This machine is well known as a strongly built, smooth running and first class registering machine, and the size is one that can conveniently be used for small work, as well as for printing a sheet 36″ × 24.″ This size will be of great service to the Office, as by helping with the smaller work it will leave the two larger machines (Quad Crowns) free for the printing of double elephant and atlas size work, of which there is generally sufficient to keep both running continually. An extra set of inking rollers has been ordered for the new machine, as it will be largely used for printing colour work.

During the past year some inconvenience has been felt for want of beds for printing thin zinc plates, and these have also been indented for. At present the beds in the office consist of one double elephant bed, another large odd size, two imperials and one foolscap. A new double elephant bed is required to enable the two large machines to be employed on that size of work simultaneously if necessary. As a large proportion of the work done is imperial size, another bed of that size is necessary to enable the two large machines and the new one to be employed, when required, on work of that size at the same time. Lastly, a new foolscap size bed is required so that the new machine and the present small machine can be employed together on foolscap size work. Owing to the want of these beds, large plates have on several occasions had to be cut down to fit the smaller beds when work was urgently required, and sometimes, when this has been impossible, urgent work has had to be kept standing till the required bed was at liberty.

A spare set of high and low pressure pistons for the engine are urgently required to replace those now in use in case of an accident. The old ones already show signs of wear, having been in continuous use for nine years, and if it were impossible to replace them in case of emergency, the whole work of the Office would be suspended indefinitely. These have now been indented for.

THE ECLIPSE OF 1898.—In June 1897 I received instructions to organize a small party from the Photographic Branch of this office, to proceed to Bihar in January 1898 to obtain photographs of the corona at the total solar eclipse on the 22nd of that month. The old photo-heliograph used by Colonel Tennant at Dodabetta, on the Nilgiris, to observe the total eclipse of 1871, and again by Colonel Waterhouse at Camorta, in the Nicobars, in 1875, was still available, and it has been put in thorough order in the Mathematical Instrument Office, where also a driving clock, furnished by the Trigonometrical Branch Office at Dehra Dún, was adjusted to it. The lens used on previous occasions was not available, but a similar one, by Dallmeyer, of suitable capacity, is in use in the office and will answer perfectly. I have been in correspondence with Captain Hills, R.E., Secretary of the Joint Permanent Eclipse Committee, and with Mr. C. Michie Smith, Government Astronomer, Madras, on the subject of the precautions to be taken to ensure success, and have read all the available literature on the subject, including nearly every published report upon previous solar eclipses, and was thus able to formulate a programme for the forthcoming eclipse, which, given good weather, should ensure the success of our observations in January next. Buxar was at first the place chosen as an observing station, but on its becoming known that the centre of the zone of totality would pass some miles to the east of that place, I decided to establish my camp at Dumraon, where Mr. Chas. Fox, the Manager of the Maharani's Estates, has kindly volunteered, on behalf of the Maharani, to give me all needful assistance.

REORGANIZATION OF THE OFFICE.—Shortly after I assumed charge of the office, I was instructed by the Surveyor-General to prepare a scheme having for its object the grading of the entire establishment of the office (excepting the clerical staff) in one list for the purposes of promotion, in order to abolish as far as possible the system of progressive salaries which has hitherto obtained. The scheme was also to provide for the amalgamation of the photo-zinco. and type-printing staff of the Trigonometrical Branch Office at Dehra Dún with the establishment of this office. The preparation of this scheme occupied a large share of my attention during the latter part of the year, and before its close it was completed and forwarded to the Surveyor-General for approval and submission to the Government of India.

PHOTOGRAPHIC AND

Abstract of Departmental work

Specification.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic and Lithographic Printing. Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Stones.	Pulls.	Number of copies. Coloured.	Uncoloured.	Total.
Departmental Maps, Plans, etc.										
General Maps	2	...	...	...	46	4	13,775	1,000	2,865	3,865
Provincial Maps	14	24	24	6	4	13	3,263	500	1,029	1,529
Divisional Maps	8	4	4	2	4	...	800	...	800	800
District Maps	47	64	66	36	51	18	9,442	...	9,472	9,472
Plans of Cities and Cantonments	72	118	87	36	118	...	9,750	...	9,750	9,750
Standard Maps	551	733	517	214	118	1	19,050	...	17,783	17,783
Index Maps	40	129	138	88	57	4	36,585	24,574	4,758	29,332
Atlas Sheets	2	...	...	...	...	2	158	...	156	156
Technical Charts	...	...	...	...	4	...	100	...	100	100
Miscellaneous Maps, Plans, etc.	300	303	355	127	105	18	15,457	125	24,871	24,996
Transfers and Proofs	...	...	...	...	...	...	1,625	...	1,935	1,935
Departmental Forms	13	...	...	...	2	16	23,318	100	30,259	30,359
Type Printings	...	...	...	...	...	...	...	...	...	...
Totals (Normal)	1,049	1,375	1,191	509	509	76	133,323	26,299	103,778	130,077
Cadastral Maps.										
Bengal—										
Photo-zincographs	124	124	124	135	135	...	3,510	...	3,510	3,510
Zincographs	138	...	...	138	138	...	3,588	...	3,588	3,588
Totals	262	124	124	273	273	...	7,098	...	7,098	7,098
North-Western Provinces—										
Photo-zincographs	2,305	2,305	2,276	2,332	2,332	...	30,316	...	30,316	30,316
Zincographs	668	...	...	668	668	...	8,684	...	8,684	8,684
Totals	2,973	2,305	2,276	3,000	3,000	...	39,000	...	39,000	39,000
Assam—										
Photo-zincographs	140	140	109	98	98	...	4,987	...	4,987	4,987
Zincographs	41	...	...	41	41	...	2,173	...	2,173	2,173
Totals	181	140	109	139	139	...	7,160	...	7,160	7,160
Burma—										
Photo-zincographs	1,487	1,487	1,462	1,502	1,502	...	46,436	...	46,436	46,436
Zincographs	731	...	...	731	731	...	22,599	...	22,599	22,599
Totals	2,218	1,487	1,462	2,233	2,233	...	69,035	...	69,035	69,03
Transfers and Proofs	...	...	...	...	...	...	10,930	...	...	...
Totals (Cadastral)	5,634	4,056	3,971	5,645	5,645	...	133,223	...	122,293	122,293

LITHOGRAPHIC OFFICE.

done during the year 1896-97.

Type Printing.			Silver and other Printing.		Heliogravure & Electrotyping.				Value.	Remarks.
Pages or Items.	Pulls.	Copies.	Silver Prints.	Blue Prints.	Heliogravure Plates.	Heliogravure Prints.	Photo. Blocks.	Electrotypes.	Rs. A. P.	
...	...	...	...	...	...	...	...	...	3,457 1 6	
...	...	...	...	...	...	...	...	...	1,137 11 9	
...	...	...	...	...	...	...	...	...	389 7 9	
...	...	...	...	41	...	...	...	...	4,976 2 3	
...	...	...	...	184	...	...	...	...	4,716 1 6	
...	...	...	...	2,238	...	...	...	...	18,451 15 3	
...	...	...	...	101	...	...	...	...	3,796 7 9	
...	...	...	...	...	...	...	...	...	452 0 0	
...	...	...	...	...	...	...	...	...	47 3 0	
...	...	...	137	135	13	3,919	...	13	9,530 10 0	
...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	1,478 10 0	
10,054	931,543	529,664	...	...	...	...	...	...	12,261 10 0	
10,054	931,543	529,664	137	2,699	13	3,919	...	13	60,695 0 9	
...	...	...	...	...	...	...	...	...	1,966 0 6	
...	...	...	...	...	...	...	...	...	1,097 1 6	
...	...	...	...	...	...	...	...	...	3,063 2 0	
...	...	...	...	...	...	...	...	...	30,186 0 0	
...	...	...	...	...	...	...	...	...	3,887 12 9	
...	...	...	...	...	...	...	...	...	34,073 12 9	
...	...	...	...	...	...	...	...	...	2,161 3 3	
...	...	...	...	...	...	...	...	...	522 12 0	
...	...	...	...	...	...	...	...	...	2,683 15 3	
...	...	...	...	...	...	...	...	...	23,331 4 6	
...	...	...	...	...	...	...	...	...	6,115 13 0	
...	...	...	...	...	...	...	...	...	29,447 1 6	
...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	69,267 15 6	

PHOTOGRAPHIC AND

Statement of Work done for other

Departments, etc.	Sheets or Subjects.	Negatives and transparencies.	Photo-Zincographic and				
			Photo-transfer Prints.	Zinc Plates transferred.	Zinc Plates printed.	Stones.	Pulls.
Adjutant General in India	8	...	...	...	8	10	12,185
Agent to the Governor General, Central India and Rajputana	1	...	...	...	...	3	180
Agent and Chief Engineer, Bombay, Baroda and Central India Railway	4	4	4	3	9	1	18,150
Agent and Chief Engineer, Bengal and North-Western Railway	18	13	13	11	11	4	1,500
Archæological Surveyor, North-Western Provinces and Oudh	8	8	2	...	...	1	500
Architectural Surveyor, North-Western Provinces and Oudh	99	99	20	1	13	5	11,700
Asiatic Society, Bengal	62	58	...	...	...	7	8,860
Assistant Adjutant General, Mhow District	2	...	...	...	1	1	1,000
" Lahore District	...	...	...	...	4	...	1,700
Board of Revenue, Bengal	24	...	...	...	29	13	10,945
" North-Western Provinces and Oudh	...	...	...	...	6	...	1,200
Calcutta Municipality	2	11	11	3	3	1	1,300
Chief Commissioner, Assam	6	...	...	...	12	6	11,945
" Central Provinces	1	...	...	...	...	3	900
Chief Engineer, Bengal, Public Works Department	14	5	5	1	15	8	3,962
Chief Engineer, Punjab, Public Works Department	3	4	4	1	1	2	600
" , Irrigation Works	10	4	4	6	12	4	21,900
" East Indian Railway, Allahabad	47	45	45	21	18	...	2,372
" Indian Midland Railway	1	...	...	...	...	2	200
Chief Commissioner, Coorg	1	...	...	...	4	1	150
Chief Commissariat Officer, Lahore Command	1	...	...	...	...	1	12
Collector of Customs, Calcutta	7	...	...	...	...	10	5,250
" Muzaffarpur	1	...	...	1	1	6	800
Commissioner, Ajmere-Merwara	...	...	...	...	1	...	200
" Patna	1	...	...	...	5	1	600
" of Excise, Bengal	5	...	...	...	...	7	3,430
" " Punjab	2	...	...	...	...	4	860
" of Police, Calcutta	1	...	...	...	...	2	2,128
" Salt, Abkari, etc., Madras	1	...	...	...	5	1	2,220
Commissary General, Bengal Command	...	...	...	...	...	...	...
" General-in-Chief	9	...	...	...	...	2	240
Comptroller General, India	2	1	...	...	...	...	...
Conservator of Forests, Bengal	2	...	...	...	...	1	20
Deputy Adjutant General, Bengal	5	2	2	1	4	1	162
" " Madras	...	...	...	...	1	...	50
Deputy Assistant Adjutant General, Allahabad District	1	2	2	1	1	...	200
" Peshawar District	1	2	2	1	3	...	150
Deputy Commissioner, Hissar	1	4	4	1	1	...	100
" Ludhiana	1	...	...	...	...	1	50
" Pegu	1	...	...	...	1	...	300
" Umballa	1	...	...	...	...	1	100
Deputy Consulting Engineer to Government of India for State Railways	45	53	53	29	25	[illegible]	7,840
Deputy Post Master General, Rajputana	1	...	...	...	2	...	262
Director General of Military Works	16	30	30	11	12	...	4,125
" of Telegraphs	8	...	...	...	...	9	4,520
Director, Geological Survey of India	30	1	...	...	...	14	5,315
" Land Records and Agriculture, Assam	1	...	...	1	1	1	340
" " Bengal	6	2	...	...	4	9	6,528
" " Burma	30	84	84	30	40	...	480
" " Gwalior State	2	...	...	...	...	2	3,000
" " Punjab	2	2	2	1	...	1	1,005
" Military Education, India	7	...	...	...	10	7	5,100
" Public Instruction, Bengal	4	...	...	...	2	2	2,392
" Royal Indian Marine	23	23	...	...	...	...	...
Engineer-in-Chief, Eastern Bengal State Railway	15	...	...	...	2	9	526
" North-Western Railway	4	...	...	...	...	4	2,200
" Rohilkhand Province	...	...	...	...	6	...	300
" Singia-Madaripur Chandpur Railway Survey	4	22	22	12	12	...	600
Examiner of Accounts, Eastern Bengal State Railway	1	...	...	...	...	1	200
" of Telegraph Accounts	...	...	...	...	1	...	200
Executive Engineer, Burma State Railway	2	...	...	...	...	1	100
" Eastern Bengal State Railway	1	...	...	...	...	2	150
General Officer Commanding Assam District	1	1	1	1	1	...	50
General Officer Commanding Meerut District	...	...	...	...	2	...	50
Carried over	557	480	310	137	286	183	169,404

LITHOGRAPHIC OFFICE.

Departments during the year 1896-97.

Lithographic Printing.			Silver and other Printing.		Heliogravure and Electrotyping				Value.		
Number of copies.											
Colored.	Uncolored.	Total.	Silver prints.	Blue prints.	Heliogravure plates.	Heliogravure prints.	Photo-Blocks.	Electrotypes.	R	a.	p.
4,620	635	5,255	...	...	...	...	...	...	1,878	5	0
60	...	60	...	...	...	...	...	...	174	14	0
2,000	150	2,150	...	...	...	...	...	...	1,208	9	3
...	1,900	1,900	...	...	...	...	...	...	562	4	0
...	1,000	1,000	...	...	6	3,006	...	...	891	8	0
...	42,250	42,250	20	170	40	12,590	...	...	6,835	6	9
2,600	3,920	6,520	...	130	27	14,377	...	...	5,189	5	0
...	1,000	1,000	...	...	...	...	...	...	51	4	0
...	1,700	1,700	...	...	...	...	...	...	427	13	0
9,265	...	9,265	...	...	...	...	...	...	1,899	8	0
...	1,200	1,200	...	...	...	...	...	...	399	1	0
...	1,300	1,300	...	...	...	...	...	...	443	7	3
1,480	6,025	7,505	...	...	...	...	...	...	805	1	0
300	...	300	...	...	...	...	...	...	55	15	0
850	3,462	4,312	...	1	...	...	...	...	1,012	3	0
...	600	600	...	...	...	...	...	...	329	3	0
...	16,150	16,150	...	...	...	...	...	...	1,177	6	0
...	4,330	4,330	...	...	...	...	...	...	909	0	6
100	...	100	...	...	...	...	...	...	27	14	0
30	...	30	...	...	...	...	...	...	49	0	0
...	12	12	...	...	...	...	...	...	114	0	0
3,675	...	3,675	...	...	...	...	...	...	638	15	0
100	100	200	...	...	...	...	...	...	117	11	6
...	200	200	...	...	...	...	...	...	13	8	0
100	...	100	...	...	...	...	...	...	101	13	0
2,450	...	2,450	...	...	...	...	...	...	322	13	0
430	...	430	...	...	...	...	...	...	112	0	0
1,064	...	1,064	...	...	...	...	...	...	234	3	0
370	...	370	...	...	...	...	...	...	223	3	0
...	...	...	12	...	...	...	...	...	4	8	0
...	1,080	1,080	...	...	...	...	...	...	402	1	0
...	...	...	1	1	...	...	...	...	10	0	0
...	40	40	...	...	...	...	...	...	9	10	0
...	312	312	...	...	...	...	...	...	116	11	0
...	... 50	50	...	...	...	...	...	...	12	7	3
...	200	200	...	...	...	...	...	...	82	5	0
...	450	450	...	...	...	...	...	...	149	0	3
...	100	100	...	...	...	...	...	...	87	0	3
...	50	50	...	...	...	...	...	...	38	10	0
...	300	300	...	...	...	...	...	...	82	15	0
...	100	100	...	...	...	...	...	...	78	0	0
50	9,720	9,770	...	...	...	...	...	...	1,635	4	6
...	131	131	...	...	...	...	...	...	196	13	0
...	4,525	4,525	...	...	...	...	...	...	1,130	15	9
...	3,370	3,370	...	...	...	...	...	...	999	0	0
1,025	780	1,805	72	46	1	601	...	...	860	2	0
...	340	340	...	...	...	...	...	...	45	11	6
2,000	528	2,528	...	...	2	1,002	...	...	561	1	0
...	480	480	...	...	...	...	...	...	1,781	8	0
...	6,000	6,000	...	...	...	...	...	...	422	1	0
...	1,005	1,005	...	...	...	...	...	...	70	4	0
2,100	...	2,100	...	...	...	...	...	...	999	13	0
2,392	...	2,392	...	...	...	...	...	...	180	13	0
...	...	...	...	...	13	2,763	...	...	1,287	8	0
297	388	685	...	...	...	...	...	...	244	15	0
...	2,200	2,200	...	...	...	...	...	...	833	0	0
...	300	300	...	...	...	...	...	...	111	14	6
...	450	450	...	...	...	...	...	...	418	1	0
...	200	200	...	...	...	...	...	...	28	4	0
...	400	400	...	...	...	...	...	...	6	11	6
...	200	200	...	...	...	...	...	...	67	0	0
75	...	75	...	...	...	...	...	...	29	7	0
...	50	50	...	...	...	...	...	...	34	9	6
...	50	50	...	...	...	...	...	...	17	7	9
37,433	119,733	157,166	105	348	89	34,339	...	...	39,240	11	0

PHOTOGRAPHIC AND

Statement of Work done for other

Departments, etc.	Sheets or Subjects.	Negatives and transparencies.	Photo-Zincographic and				
			Photo-transfer Prints.	Zinc Plates transferred.	Zinc plates printed.	Stones.	Pulls.
Brought forward	557	480	310	137	286	183	169,404
General Officer Commanding Punjab Frontier Force	1	2	2	1	...	...	...
Government of India, Revenue and Agricultural Department	34	30	...	...	16	7	10,230
Government of India, Finance and Commerce Department	1	2	2	1	1	...	24
Government of India, Foreign Department	26	5	5	3	11	19	1,068
" Home Department	1	...	...	...	...	10	3,000
" Military Department	12	6	2	1	...	6	142
" Public Works Department	26	2	2	...	28	22	30,194
Government of Bengal, Revenue and General Department	...	...	...	...	...	2	26,770
Govermment of Bengal, Financial Department	...	...	...	...	...	...	686
" Judicial and Political Department	...	...	...	...	...	2	24
Government of Bengal, Marine Department	20	...	...	...	12	8	3,920
" Public Works Department, Irrigation Branch	15	18	55	24	24	12	9,110
Government of North-Western Provinces and Oudh, Public Works Department	1	2	2	1	1	...	300
Government of Punjab, Public Works Department	1	...	...	...	...	1	505
" Revenue Department	...	...	...	...	...	1	300
Indian Museum	...	...	...	...	...	...	...
Indian Famine Charitable Relief Fund Office	1	2	...	...	...	...	...
Inspecting Officer, Central India Imperial Service Cavalry	1	3	3	1	1	...	75
Inspector General of Artillery in India	5	...	...	...	...	6	2,200
" of Civil Veterinary Department	2	...	...	...	1	2	620
Inspector General of Police, Bengal	10	7	7	3	5	14	11,480
Marwar State	8	12	12	8	...	...	...
Meteorological Reporter, Government of Bengal	4	...	...	...	1	4	20,109
" " Government of India	59	1	1	1	41	22	148,760
Narayanganj Municipality	1	...	...	...	...	8	800
Natural History Society, Bombay	1	...	...	...	...	2	2,000
Officer Commanding Belgaum District	...	...	...	...	...	...	1,800
" Bundelkhand District	3	8	8	4	4	...	510
" Lahore District	3	6	6	2	9	1	620
" Hyderabad contingent	1	1	1	1	...	...	...
Photographic Society, India	5	6	...	...	...	...	...
Port Commissioners, Calcutta	5	32	32	13	13	...	1,250
Port Officer and Registrar of Wrecks, Calcutta	6	2	2	1	1	7	977
Principal, Dacca College	...	...	...	...	...	...	150
" Civil Engineering College, Sibpur	...	...	...	...	...	...	...
Quarter Master General in India	7	2	8	2	25	11	16,279
Reporter on Economic Products, Government of India	7	...	...	...	3	7	21,500
Resident, Western Rajputana State	9	16	16	8	...	1	50
Revenue Surveys, Batu Gajah, Straits Settlements, Perak	...	...	...	1	1	...	10
Royal Survey Department, Siam	15	47	47	22	25	...	1,570
Sanitary Commissioner, Assam	2	...	...	...	...	2	900
" " Bengal	11	5	4	...	5	4	6,390
" " Central Provinces	...	...	...	...	1	...	275
" " Hyderabad Assigned Districts	11	...	...	...	10	6	3,200
" " India	9	2	...	...	...	16	5,400
" " North-Western Provinces and Oudh	3	...	...	...	...	4	1,852
Secretary for Berar to the Resident at Hyderabad	22	...	...	...	1	2	1,000
" Calcutta Building Commission	24	...	...	...	...	6	296
" Lady Dufferin's Fund	2	2	1	...	...	2	3,000
" Transport Committee, Rawal Pindi	2	8	8	2	...	2	680
Station Staff Officer, Sialkot	...	...	...	...	1	...	100
Settlement Officer, Cuttack	...	...	...	...	...	...	...
Superintendent, Archæological Survey, Madras	63	41	41	16	...	...	...
Superintendent, Campbell Medical School and Hospital	1	...	...	...	...	1	164
" Forest Surveys, Dehra Dun	...	...	...	...	...	8	2,280
" Government Printing, India	142	44	13	4	25	41	55,785
" Stationery, Calcutta	6	...	...	...	5	4	9,483
" Telegraph Stores	2	...	...	...	1	1	3,670
Superintending Engineer, Sone Circle	6	6	6	3	3	...	225
Traffic Superintendent, Eastern Bengal State Railway	1	...	...	...	...	1	200
Special Work done for Trade private individuals	42	41	36	24	34	10	3,429
Transfers and Proofs	...	...	...	...	...	...	2,633
Total	1,197	841	632	284	595	468	587,399

LITHOGRAPHIC OFFICE.

Departments during the year 1896-97.

Lithographic Printing.			Silver and other Printing.		Heliogravure and Electrotyping.				Value.		
Number of copies.											
Colored.	Uncolored.	Total.	Silver Prints.	Blue prints.	Heliogravure Plates.	Heliogravure Prints.	Photo.-Blocks.	Electrotypes.	R	a.	p.
37,433	119,733	157,166	105	348	89	34,339	...	...	39,240	11	0
...	...	...	...	...	...	...	...	...	34	8	0
8,200	2,030	10,230	...	31	14	11,614	...	...	3,593	9	0
...	24	24	...	...	...	...	...	...	34	10	6
238	528	766	...	...	...	6,250	...	...	2,121	11	6
600	...	600	...	...	...	...	...	...	134	3	0
30	156	186	...	12	...	...	...	...	173	13	0
3,094	21,928	25,022	...	...	...	...	...	...	4,289	2	0
18,346	...	18,346	...	...	...	...	...	...	1,193	14	0
686	...	686	...	...	...	...	...	...	30	7	0
12	...	12	...	...	...	...	...	...	2	13	0
4,190	...	4,190	...	...	...	...	...	...	501	12	0
2,040	3,050	5,090	...	53	...	...	...	...	1,709	11	9
...	300	300	...	...	...	...	...	...	70	9	0
...	505	505	...	...	...	...	...	...	127	13	0
...	300	300	...	...	...	...	...	...	29	1	0
...	...	...	40	...	...	4,310	...	...	553	14	0
...	...	...	...	...	1	201	...	...	64	8	0
...	75	75	...	...	...	...	...	...	104	10	6
200	1,600	1,800	...	...	...	...	...	...	176	8	0
...	620	620	...	...	...	...	...	...	89	0	0
4,400	42	4,442	...	...	...	...	...	...	691	9	3
...	...	...	...	...	...	...	...	...	218	0	0
146	10,020	10,166	...	...	...	...	...	...	279	10	0
20,530	174,595	195,125	...	...	...	...	...	...	4,349	2	3
...	100	100	...	...	...	...	...	...	2,032	0	0
1,000	...	1,000	...	...	...	...	...	...	57	8	0
600	...	600	...	...	...	...	...	...	175	1	0
...	430	430	...	...	...	...	...	...	289	1	0
...	420	420	...	...	...	...	...	...	346	3	0
...	...	...	...	...	...	...	...	...	20	0	0
...	...	...	...	...	6	8,231	...	...	561	0	0
...	1,250	1,250	...	...	...	...	...	...	1,099	14	3
133	578	711	...	...	...	...	...	...	310	15	0
...	150	150	...	...	...	...	...	...	29	1	0
...	...	...	...	...	...	100	...	...	12	0	0
1,940	2,659	4,599	...	6	...	...	...	...	2,129	8	3
...	19,350	19,350	72	...	...	...	...	...	2,387	8	3
...	50	50	...	...	...	...	...	...	369	8	0
...	10	10	...	...	...	...	...	...	10	14	0
...	1,670	1,670	...	...	...	...	...	...	1,287	11	6
...	900	900	...	...	...	...	...	...	164	3	0
3,550	710	4,260	...	1	...	...	...	...	712	12	0
...	275	275	...	...	...	...	...	...	38	2	0
2,200	...	2,200	...	...	...	...	...	...	763	4	0
1,450	...	1,450	...	...	1	251	...	...	791	7	0
380	1,092	1,472	...	...	...	...	...	...	214	8	0
...	9,200	9,200	...	...	...	...	...	...	211	2	0
...	1,186	1,186	...	...	...	...	...	...	269	7	0
1,500	...	1,500	...	2	...	...	...	...	341	13	0
...	340	340	...	...	...	...	...	...	420	14	0
...	100	100	...	...	...	...	...	...	22	12	0
...	...	...	...	2	...	...	...	...	2	8	0
...	...	...	...	82	1	1	...	...	649	0	0
...	164	164	...	...	...	...	...	...	13	8	0
285	...	285	...	...	...	...	...	...	471	3	0
4,392	86,723	91,115	...	31	1	601	...	...	4,936	13	0
...	9,555	9,555	...	...	...	...	...	...	576	0	0
...	4,460	4,460	...	...	...	...	...	...	128	11	0
...	225	225	...	...	...	...	...	...	94	12	6
...	200	200	...	...	...	...	...	...	215	2	0
200	3,449	3,649	...	...	5	2,429	...	...	1,570	13	0
...	2,175	2,175	...	...	...	...	...	...	......		
117,775	482,927	600,702	217	568	118	68,327	...	...	83,541	10	6

MATHEMATICAL INSTRUMENT OFFICE.

TABLE A.

Details of Issues and Receipts from Provinces and Departments during the financial year 1896-97.

Provinces and Departments.	Value of Receipts.	Value of Issues.	Value of Debits.	Value of Credits.
	R	R	R	R
Assam	21	6,667	6,646	...
Bengal, Civil	12,715	68,258	55,543	...
" Military, Bengal Command	666	2,288	1,622	...
" " Punjab "	7,130	13,223	6,093	...
Bombay, Civil	1,140	3,111	1,971	...
" Military	6	946	940	...
Burma	5,747	22,716	16,969	...
Central India	1	...	...	1
" Provinces	320	10,914	10,594	...
Foreign States, Berar	...	239	239	...
Forests	131	1,789	1,658	...
Geological Survey and Museums	...	372	372	...
Guaranteed Railway, East Indian Railway	...	6,112	6,112	...
Indian Midland Railway	...	68	68	...
Land Revenue, Coorg	...	77	77	...
Madras, Civil	6,688	7,174	486	...
" Military	8	239	231	...
Marine	259	1,455	1,196	...
Meteorological Department	...	1,421	1,421	...
Mint	157	...	...	157
North-Western Provinces and Oudh	1,902	13,212	11,310	...
North India Salt Revenue	215	421	206	...
North-Western State Railway, Public Works Department	2,561	11,968	9,407	...
Public Works Department, Military Works	836	4,810	3,974	...
Public Works Department, Baluchistan Railway Branch	328	...	...	328
Port Blair	...	286	286	...
Punjab	12,609	13,993	1,384	...
Rajputana-Malwa Railway	...	71	71	...
" Public Works Department and Central India	...	543	543	...
Survey Department (Field Parties)	41,741	43,954	2,213	...
Ditto ditto Head Quarters' Offices, Calcutta and Dehra Dun	2,550	11,653	9,103	...
TOTAL	97,731	2,47,980	1,50,735	486
NET DEBIT	...	...	1,50,249	...
CASH SALES	...	...	31,128	...
GRAND TOTAL			1,81,377	...

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the Local Market during 1896-97.

SPECIFICATION.	No.	Value.	
Instruments.		R	a.
Barometers, aneroid pocket, ordinary	6	397	8
Boards, drawing or sketching, cavalry pattern	40	1,350	0
Cards for prismatic compasses	4	2	0
Cases, leather and morrocco spare	163	577	8
Chronographs, watch pattern	3	75	0
Clinometers, Watkin's pattern	6	165	0
Clocks	7	188	8
Compasses, bow dividers electrum spring	12	24	0
" " ink, brass, single jointed	24	108	0
" " " " double jointed	6	45	0
" " " electrum single jointed	36	189	0
" " " " double "	6	51	0
" drawing, ordinary, brass, 6"	12	33	0
" " hair spring, electrum, 5"	12	72	0
" magnetic, pocket, in brass case	6	90	0
" " rectangular, 2" and 2½"	61	427	0
" " " 5"	80	1,040	0
" " " 6"	42	630	0
" Napiers	20	350	0
" prismatic, S. R. 3½"	3	225	0
" " S. R. 4"	3	270	0
" proportional, brass, 6"	7	122	8
" " electrum, 6"	6	110	4
Covers for planetables	132	738	14
Curves, French, wooden, sets	1	7	8
" Railway Cardboard, small, sets	1	19	8
Glasses, binocular, large	3	200	0
" " small	5	225	0
" magnifying or reading in metal frames 2" or 3"	4	18	0
" " " " " 3½" to 4½"	6	30	0
Ghat tracers	1	53	12
Haversacks	100	150	8
Hydrometers, Syke's, brass floats, sets	6	405	0
Hygrometers, Mason's	6	90	0
Instruments, drawing, brass, 1st sort	2	130	0
" " " 2nd "	12	600	0
" " " 3rd "	6	144	0
" " electrum, 1st "	2	150	0
Levels, reflecting, Abney's	14	588	0
Level, spirit, in metal case	7	224	0
" " " " 4" to 7"	14	17	12
" " wooden " 8" to 14"	12	16	0
" " " " 11" to 15"	39	89	4
Machine, map printing, ordnance	6	285	0
Pens, drawing, ivory handles	200	600	0
" double or road	6	36	0
Pins for chains, ordinary	7,000	437	8
" for maps, brass	144	9	0
" for maps, electrum	288	18	0
Protractors, brass, circular, plain, 6"	2	53	0
" electrum, semi-circular plain	2	51	0
" rectangular, ivory, 6"	28	147	0
" " wooden, 6"	29	61	2
Rules, flat, ebonite, plain, 6"	99	49	8
" " " 12" and 18"	24	21	0
" parallel bar, wooden, 6"	35	35	0
" " " " 12"	6	18	0
" " on rollers, brass, 6" and 9"	3	51	0
Carried over	8,810	12,311	8

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the Local Market during 1896-97—contd.

Specification.	No.	Value.	
Instruments—concld.		R	a.
Brought forward	8,810	12,311	8
Rules, parallel bar, wooden 15″ and 18″	11	392	8
„ „ „ „ 2′ to 3′	4	243	0
„ „ „ „ 3½′ to 4½′	2	220	0
„ „ „ electrum, 6″ to 9″	5	90	0
Scales, architects, ivory universal, 12″	5	50	0
„ diagonal, wooden	1,000	562	8
„ offsets, single, ivory	150	75	0
„ „ „ wooden	36	13	8
„ plotting, sets, wooden	12	216	0
„ „ single „	48	121	8
Set squares, sets ebonite	20	162	0
„ „ single, ebonite	102	218	4
Set squares, single, wooden	11	18	10
Slide Rules	3	98	0
Squares optical	90	585	0
Stands for Prismatic Compasses	6	105	0
„ for Planetables, military	18	324	0
„ for Theodolites, transit Railway	1	50	0
Staves, levelling, Sopwith's telescopic	305	4,575	0
Sundials	6	150	0
Tapes, measuring, metallic, 50′	780	3,418	
„ metallic of sizes	3	21	0
Telescopes, various of sorts	12	144	0
Theodolite transit with complete, v.c. Ry : 5″	1	525	0
Thermometers, chemical or Traveller's from 0° to 400°	12	87	0
„ minimum, self registering	6	96	0
„ oven	6	300	0
Trunks mule	12	162	0
Umbrellas, surveying	67	1,005	8
Watches, common	100	3,975	0
Type-writers	1	456	0
TOTAL	11,645	30,771	4
Books.			
Hints to Travellers	1	7	3
Manual of Surveying, Thuillier's	2	24	0
Nautical almanacs	90	180	0
Tables Log, Shortredes, Sines, etc.	9	206	4
„ traverse, Boileaus	12	108	0
TOTAL	114	525	7
Sundries.			
Brushes, stencil	60	30	0
Glasses, ink bottles	108	40	8
Scale, letter weighing	2	41	12
Sketch, block	2	4	8
Type wheel	1	10	8
Presslers borers for hardwood	8	133	0
Carried over	181	260	4

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the Local Market during 1896-97—concld.

Specification.	No.	Value. R	a.
		R	a.
Brought forward	181	260	4
Stencil, ink, black	24	12	0
Punching Machine	1	19	4
Eyelet hole, brass	80	32	8
Rubber, elastic bands, for cavalry board	60	15	0
India rubber tubing	8	20	0
Letters, spare dogs Yost	1	10	8
Lactometers	3	7	8
TOTAL	358	377	0
TOTAL OF BOOKS	114	525	7
TOTAL OF INSTRUMENTS	11,645	30,771	4
SUM TOTAL	12,117	31,673	11

MATHEMATICAL INSTRUMENT OFFICE.

TABLE C.

Instruments, etc., manufactured in the Mathematical Instrument Office during 1896-97.

Specification.	No.	Value. R	a.
Instruments.			
Bars, standard, steel	9	288	0
Boards, drawing, deal	90	1,139	0
Chains, iron, 66 feet	540	1,890	0
" steel	131	1,285	0
Clinometers, survey pattern	34	1,020	0
" wooden, with shade scales	12	18	0
Compasses, magnetic, rectangular, 5 inch	43	559	0
" " " 6 inch	51	813	0
Curves, railway, card board, large, sets	1	27	8
Glasses, copying or tracing	9	330	0
Hold-alls, leather	102	1,734	0
Ink rollers	2	5	0
Instruments, drawing, brass, 3rd sort	1	11	0
Lamps, referring	12	72	0
Levels, water	12	192	0
Map, printing machine, Ordnance	1	40	0
Pin lifters	6	3	0
Plane tables, deal, survey pattern	272	1,850	0
" " " Military "	1	75	0
Pluviometers, Symon's	1	13	0
Rods, measuring	450	823	12
Rules, flat, wooden, plain, 2 feet and 2 feet 6 inch	7	25	0
" parallel, on rollers, brass, 15 inch and 18 inch	6	180	0
" sight, brass	1	16	0
Scales, card board, miscellaneous	800	200	0
" diagonal, card board	2,000	375	0
" engineering, metal	24	461	1
" offsets, single, wooden	50	9	6
" plotting, sets, ivory	2	103	4
" " single, metal	1	5	0
Sheets, celluloid	1,250	877	0
Squares, optical	1	6	8
Stamps for conventional signs	15	39	8
Stands for Heliotropes	60	960	0
" " Theodolite Transit Railway 5 inch	1	40	0
Staves, levelling, Roorkee, double	50	1,237	0
" " telescopic, Sopwith's	162	4,117	8
Stencil plates, various	548	1,142	14
Telescopes, spare, for Range Finders	4	27	7
TOTAL	6,762	22,010	12
Books.			
Traverse Indicator card by Reynolds	50	125	0
Sundries.			
Boxes, deal wood and mahogany, with locks	1	3	15
Boxes of sorts	15	37	8
Table	1	40	0
Top for raingauge, with bottle	1	6	0
Carried over	18	87	7

MATHEMATICAL INSTRUMENT OFFICE.

TABLE C.

Instruments, etc., manufactured in the Mathematical Instrument Office during 1896-97—concld.

Specification.	No.	Value.	
Sundries—contd.		R	a.
Brought forward	18	87	7
Scales, plotting, brass, 2 inch square, with 2 scales, wooden, marked in chains	10	25	0
Screws, brass, with washers, for plane tables	6	15	0
Scales, 2 inch square, brass	10	25	0
Numbers for chains	100	18	12
Zinc tickets	64	2	2
Brass screws for plane tables	2	3	0
Ferrotype frames	1	80	0
Numbers for chains, brass	5	5	0
Brass plates	1	375	0
Trestles for drawing boards	2	20	0
Instrument for measuring range	1	100	0
Clamping screws	3	5	8
Winged "	2	4	0
Staves, levelling	5	5	0
Knife and 4 screws Compass, eyepiece Capstan bar	3	1	8
TOTAL	233	772	5
TOTAL BOOKS	50	125	0
TOTAL INSTRUMENTS	6,762	22,010	12
SUM TOTAL	7,045	22,908	1

MATHEMATICAL INSTRUMENT OFFICE.

TABLE D.

List of principal instruments repaired in Workshop during the financial year 1896-97.

Specification.	Number.
Anemographs of sorts	4
Anemometers of sorts	22
Balance, chemical	1
Barometers of sorts	113
Boards of sorts	3
Callipers, sliding	1
Camera	1
Cards of sorts	50
Chains of sorts	72
Chronographs of sorts	12
Chronometers of sorts	9
Chrono-micrometers	3
Circumferentors	2
Clinometers of sorts	64
Clocks of sorts	9
Compasses, beam	3
" bow ink or pen of sorts	83
" " pencil of sorts	2
" " spring of sorts	5
" dividers	4
" drawing of sorts	532
" magnetic, rectangular, of sorts	70
" marine	3
" prismatic of sorts	129
" proportional	8
" surveying	19
" of sorts	7
Cord and reel	36
Curves	2
Declinometers	2
Eidographs	1
Galvanometer	1
Ghat tracer	1
Glasses, binocular, of sorts	55
Heliographs	27
Heliotropes	12
Hydrometers	39
Hygrometers	4
Indicator	1
Instruments, drawing, mathematical, of sorts	105
Lamps of sorts	6
Lenses, reading	3
Levels of sorts	187
Mekometers	83
Magnet bar	1
Micrometers	2
Microscopes	2
Mining dial	5
Mirror	4
Pens, drawing	185
Pins of sorts	7
Plane tables	14
Planimeters	13
Prickers, ivory handles	1
Protractors	4
Quadrant, gunner's	2
Quintant, sounding	8
Rain-gauges	4
Range Finders	17
Carried over	2,065

MATHEMATICAL INSTRUMENT OFFICE.

Table D.

List of principal instruments repaired in Workshop during the financial year 1896-97.—concld.

Specification.	Number.
Brought forward	2,065
Rules of sorts	462
Scales of sorts	167
Scott's sights, B. L. telescopic	119
Sextant of sorts	18
Squares, optical	251
Stands for compasses of sorts	79
" for camera	1
" for circumferentor	2
" for curve ranger	1
" for levels	89
" for mining dials	3
" for plane tables	18
" for theodolites	65
" for sextants	1
" for heliographs	11
Station pointer	2
Staves, levelling, of sorts	120
Stencil plates	3
Tacheometer	1
Tapes of sorts	542
Telemeters of sorts	26
Telescopes of sorts	217
Theodolites of sorts	120
Thermometers of sorts	100
Time piece	2
Type writers	20
Vanes wind	1
Watches of sorts	21
Total of principal instruments repaired	4,227
Total of minor instruments repaired	1,057
Total of all instruments repaired	5,284

MATHEMATICAL INSTRUMENT OFFICE.

Profit and Loss Account of the Workshop for the financial year 1896-97.

Debits.	R	a.	Credits.	R	a.
To Workshop establishment (less proportion debitable to the Store Branch for cleaning and adjusting serviceable instruments, . .	37,513	13	By repairs for public officers on book debit 11,587 11		
" One-third of office establishment	2,731	8	" repairs for public officers on payment 9,287 4	20,874	15
" Pay of Material Storekeeper for the whole year . .	780	0	" repairs for stock . .	33,115	10
" Workshop contingencies as distinguished from materials purchased . . .	3,351	0	" Manufacture for stock—		
			Instruments . .	22,530	1
" Value of materials :— For ordinary work . . . " general workshop use. " manufacture of packing cases . .	22,855	2	Packing cases . .	1,276	4
			" Manufacture of material .	4,808	6
" Paid for repairs . .	259	12			
" Wear and tear of plant .	851	2			
" Half of rent at R600 per mensem	3,600	0			
" Printing and stationery .	360	0			
" Four per cent. on value of tools and plant amounting to R1,36,221-11	5,448	14			
" Half of taxes, rates, etc. .	877	0			
" Liability for pensions .	3,948	0			
" Profit	28	11			
TOTAL .	82,604	14	TOTAL .	82,604	14

TRIGONOMETRICAL BRANCH OFFICE, DEHRA DÚN.

Narrative Report of Mr. H. W. Peychers, Extra Assistant Superintendent, 1st grade, in charge Computing Office, Season 1896-97.

Regular monthly magnetic observations have been taken since January 1897. The results are tabulated with those taken here previously, and appended to this report.

The second edition of the Hand-Book of Professional Instructions for the Topographical Branch was completed and issued.

Mr. A. E. Wackrill, Superintendent of Trigonometrical Surveys, Ceylon, joined the office on the 27th September, with the view of acquainting himself with the methods of observing and computing, as well as with all details in connection with field and office work obtaining in the Survey of India Department.

Mr. E. Vredenburg, B.L., B. SC., A. R. C. S., Assistant Superintendent of the Geological Survey of India, was instructed in plane-tabling and triangulation during October 1896.

The following changes took place in the *personnel* of the office during the year: —

Mr. J. A. Higgs, Offg. Extra Assistant Superintendent, 6th grade, was posted to the Drawing Section from 4th March. Mr. J. S. Manuel, Zincographer, was absent on sick leave throughout the year, and Mr. G. A. LeFranc officiated for him. Mr. C. F. Guthrie, Assistant Solar Photographer, who had been on sick leave since 7th January, died on the 1st July, and Mr. R. W. Foster, of the Photo-zincographic Section, was appointed to officiate in his place. Khan Bahadur Abdul Guffar, Instructor, Training School, retired on the 1st July; Muhammad Zakaria, Surveyor, was transferred from No. 14 Party to take his place.

The cost of the Computing Section under its various class heads and the percentages thereof, together with those of the three preceding years, are given in the following statement:—

CLASS.	COST IN RUPEES.	PERCENTAGE OF COST.			
	1896-97.	1896-97.	1895-96.	1894-95.	1893-94.
1. Records, Library	883	3·0	2·9	3·4	1·4
2. Accounts, Returns, Correspondence	1,893	6·4	5·2	8·1	7·1
3. Supply of data, etc.	247	0·8	1·7	2·7	3·0
4. Computations	4,450				
5. Preparation of Press copy	7,511	79·9	78·5	75·8	78·6
6. Examination of Press proofs	11,715				
7. Ditto of charts	578	1·9	2·9	1·4	0·6
8. Protection of stations	1,002	3·4	3·3	2·2	1·2
9. Miscellaneous	952	3·2	4·4	4·3	6·2
10. Meteorology, etc.	408	1·4	1·1	1·9	1·3
11. Extra-departmental work	...	...	...	0·2	0·6
TOTAL	29,639	100	100	100	100

From the above table it will be seen that the working power of this section has been distributed much in the same way as in the preceding years.

The following is an account of the work done under the several classes shown in the foregoing table.

CLASS I.—RECORDS, LIBRARY, etc.—Five fresh instalments of field records were received during the year; these, together with those already in the office, have received the usual care and attention. The three standard copies of the library catalogue have been kept up to date.

CLASS 2.—ACCOUNTS, RETURNS AND CORRESPONDENCE.—In this is included the preparation of indents, estimates, monthly detailed and abstract progress reports, annual reports, stock returns of office stores, and various other items.

CLASS 3.—SUPPLY OF DATA.—Sixteen requisitions for data and twenty-two indents for forms were received and complied with: in all about 25,000 copies of professional and other forms were issued during the year.

CLASS 4.—COMPUTATIONS.—The following are the details:—

Indus Delta Secondary Triangulation.—The heights were recomputed, finally adjusted and entered in the pages of the co-ordinate list, this completes the work.

Electro-Telegraphic Longitudes.—Help afforded in the reduction of observations for 1894-95: a pair of computers was engaged for nearly two months.

Revision of heights of principal and secondary triangulation of the Great Arc, Section 18°-24°, Bidar and Jubbulpore Series.—This revision was necessitated by the extension of lines of spirit levels across these series which showed sensible discrepancies in the published values.

Bider Synopticıl Volume.—Triangles to certain points re-adjusted, and their latitudes, longitudes and azimuths computed.

Experimental Computations.—Formulæ investigated and examples prepared illustrating the computations of latitude, longitude and azimuth for south latitude and for longitude west of Greenwich.

Captain Deasy's Exploration in Tibet.—Computations completed.—This occupied two pairs of computers for 3½ months; the work done is as follows:—

One hundred and sixty deductions of astronomical azimuths, 140 of latitude, 225 of time, 280 of latitude, longitude and azimuth, 300 of triangles, 150 of barometrical heights and 410 of trigonometrical heights.

CLASS 5.—PREPARATION OF PRESS COPY.—This requires the abstracting and entering in suitable tables of the final results of several calculations for publication: all these compilations are twice compared, once against the original field records, and once against the final computations prior to being sent to the press. The details of the work done are as follows:—

(*a*) *Southern Trigon-Great Arc Meridional Series, Section 8°-18°.*—The final revision of the co-ordinate list, about half done.
(*b*) *Indus Delta Sècondary Triangulation.*—Co-ordinate list completed.
(*c*) *Bider Longitudinal Series—Synoptical Volume.*—Revised for second edition.

CLASS 6.—EXAMINATION OF PRESS PROOFS.—This requires the utmost care and attention in comparison and examination in the several stages of first, second and form proofs. Most of the matter printed is numerical, or depending on numerical data, hence it necessarily involves a strictly critical examination, which can only be given by men specially trained to this style of work.

The printing of the following works has been completed during the year:—

(1) Spirit-levelled Heights No. 7 C. P. (revised edition).
(2) Hand-Book of Professional Instructions for the Topographical Branch (second edition).

The tidal volume was proceeded with, 52 pages were examined and printed off. The synoptical volume of the Great Arc Meridional Series, section 8° to 18° and that of the Indus Delta Triangulation were also in hand; 66 pages of these were printed off. The printing of both these synoptical volumes is likely to be completed by next year. About 25,000 copies of professional and other forms were printed. The total amount of work executed will be seen by reference to the tabular statements of the Printing Section.

CLASS 7.—EXAMINATION OF CHARTS.—Comparison and examination of the following completed:—

Triangulation charts of Punjab Survey sheets Nos. 311, 314 and 336.
Triangulation charts of the Central Provinces Survey sheets Nos. 61, 62, 65, 66, 81 and 85.
One chart for the spirit-levelled heights No. 7 (second edition), and another chart.

Three final charts of the Great Arc Meridional Series, section 8° to 18°, and two of the Indus Delta Triangulation are in hand.

CLASS 8.—PROTECTION OF STATIONS.—The usual professional work in connection with the protection of survey stations and certain of the bench marks in the North-Western Provinces and Bengal was performed. During the year 569 stations have been repaired by the District Officers at a cost of R1,929-5-5; twenty districts out of 347 from which reports are due failed to submit them.

CLASS 9.—MISCELLANEOUS.—In this are included various duties which cannot be fairly assigned to any of the other classes, such as the following:—

(*a*) The examination and despatch of the printed papers to the Survey of India Office, Calcutta, for safe custody.
(*b*) The examination of all bound volumes and pamphlets prior to issue, and the preparation of the distribution lists and presentation labels for the same.
(*c*) The preparation of examination papers for the Provincial Service of the Survey of India Department, of which 80 sets were prepared and despatched, and 62 examined; the results were tabulated and submitted to the Surveyor-General.

CLASS 10.—METEOROLOGY AND GENERAL SCIENCE.—As hitherto, a complete set of meteorological observations was taken daily throughout the year, and monthly and

annual abstracts prepared. The meteorological results are given in the following tabular statements :—

Mean Monthly Readings of Earth Thermometers.

Depth in feet of thermometer bulbs below surface of ground.	YEAR.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.
25·6	1896-97	77·29	77·36	77·24	76·91	76·40	75·80	75·15	74·71	74·55	74·76	75·98	76·77
	Mean 1881—96	76·77	76·81	76·62	76·03	75·49	74·88	74·31	74·03	74·00	74·33	75·57	76·55
12·8	1896-97	79·99	78·91	77·29	74·97	73·00	71·75	71·91	73·57	75·73	77·42	79·50	79·91
	Mean 1881—96	79·39	78·03	75·79	73·21	71·51	70·68	71·29	73·08	75·19	77·19	79·12	79·68
6·4	1896-97	80·48	76·99	72·26	67·47	66·33	67·79	71·38	77·42	81·06	82·02	82·03	81·49
	Mean 1881—96	79·67	75·75	71·15	67·24	65·42	67·09	71·51	76·75	80·21	81·30	81·42	81·21
3·2	1896-97	79·19	73·27	66·77	62·44	61·94	67·22	75·48	84·27	85·62	84·37	82·53	82·34
	Mean 1881—95	78·12	71·65	65·51	61·88	61·24	66·69	75·43	81·97	84·66	83·35	82·05	81·69
1·1	1896-97	77·82	69·87	61·14	58·40	60·11	67·82	77·86	89·31	88·99	85·33	82·47	81·84
	Mean 1881—96	76·06	67·49	60·10	57·29	58·56	67·61	78·73	85·86	87·73	84·15	82·34	81·64
Thermometer in shade.	1896-97	82·93	73·22	66·46	64·83	68·18	76·53	88·68	95·76	92·93	83·61	80·55	82·38
	Mean 1881—96	80·38	73·37	67·76	64·08	66·91	78·64	89·82	93·81	89·92	82·47	80·67	82·54

Mean velocity in miles of the Winds which blew at Dehra Dún during the twelve months of 1896-97 for each hour of the day.

CIVIL HOURS.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	Mean.
0 to 1	1·48	0·77	0·29	0·83	0·50	0·94	1·90	0·97	1·37	0·50	0·26	0·57	0·87
1 " 2	0·77	0·47	0·23	0·90	0·61	0·94	1·40	0·97	1·27	0·67	0·29	0·37	0·74
2 " 3	0·68	0·40	0·23	0·67	0·57	0·61	1·07	0·80	0·90	0·70	0·29	0·47	0·62
3 " 4	0·45	0·37	0·16	0·53	0·75	0·84	1·57	0·67	0·97	0·50	0·26	0·27	0·61
4 " 5	0·39	0·23	0·16	0·53	0·46	0·55	1·33	0·57	0·83	0·53	0·13	0·17	0·49
5 " 6	0·45	0·27	0·10	0·73	0·39	0·55	0·73	0·37	0·80	0·47	0·19	0·10	0·43
6 " 7	0·26	0·07	0·10	0·63	0·43	0·48	0·67	0·40	0·30	0·23	0·26	0·10	0·34
7 " 8	0·23	0·03	0·10	0·60	0·54	0·61	0·50	0·50	1·17	0·43	0·29	0·13	0·43
8 " 9	0·42	0·10	0·16	0·73	0·46	0·65	1·10	0·67	1·10	1·32	0·65	0·43	0·65
9 " 10	0·52	0·43	0·29	1·19	0·71	1·35	1·33	1·20	1·77	1·77	0·84	0·70	0·98
10 " 11	1·03	0·83	0·97	1·37	1·36	2·58	2·10	2·39	2·53	1·71	1·32	0·73	1·58
11 " 12	1·65	1·37	1·55	1·67	1·86	3·16	2·83	2·32	2·60	1·68	1·19	0·73	1·88
12 " 13	1·61	1·73	1·77	1·87	2·29	3·03	3·73	2·83	2·60	1·80	1·61	1·10	2·19
13 " 14	2·06	1·57	1·74	2·40	2·61	3·84	4·37	4·03	3·80	2·27	1·77	1·27	2·64
14 " 15	1·90	1·60	1·77	1·97	2·64	3·90	4·40	4·17	3·73	2·17	1·55	1·17	2·58
15 " 16	1·39	1·40	1·32	1·90	2·57	3·42	4·20	4·70	3·07	2·00	1·32	0·83	2·34
16 " 17	0·94	0·70	0·68	1·57	2·57	3·26	4·00	3·97	3·30	1·97	1·10	0·60	2·06
17 " 18	0·39	0·23	0·19	1·37	1·57	2·32	3·37	3·30	3·43	1·57	0·48	0·37	1·55
18 " 19	0·74	0·33	0·16	1·03	0·57	1·42	2·17	2·07	1·67	1·37	0·74	0·23	1·04
19 " 20	1·29	0·73	0·19	0·60	0·82	0·94	1·83	1·30	1·23	0·77	0·58	0·23	0·88
20 " 21	1·68	0·90	0·45	0·70	1·14	1·03	1·30	1·40	1·00	0·47	0·55	0·23	0·90
21 " 22	1·55	0·77	0·58	0·77	0·96	1·26	1·80	1·40	1·00	0·70	0·55	0·33	0·97
22 " 23	1·97	0·90	0·48	0·80	1·04	1·10	1·53	1·87	1·37	0·23	0·29	0·50	1·01
23 " 24	1·48	0·77	0·48	0·67	0·82	1·48	1·50	1·53	0·93	0·23	0·32	0·73	0·91
Sums	25·33	16·67	14·15	26·03	28·24	40·26	50·73	44·40	42·94	26·06	16·80	12·36	...
Average	1·06	0·69	0·59	1·08	1·18	1·68	2·11	1·85	1·79	1·09	0·70	0·51	...

Monthly Meteorological Results of Observations taken at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún.

Year and Month.	Barometer reduced to 32° Fah. At 10 A.M. Highest.	At 10 A.M. Lowest.	At 10 A.M. Monthly mean.	At 4 P.M. Highest.	At 4 P.M. Lowest.	At 4 P.M. Monthly mean.	Hygrometer. 10 A.M. Monthly mean humidity.	Hygrometer. 4 P.M. Monthly mean humidity.	Thermometer. Dry Bulb. Highest maximum in air.	Dry Bulb. Lowest minimum in air.	Dry Bulb. Monthly mean in air.	Wet Bulb. Lowest minimum.	Rain. Number of days it fell.	Rain. Fall in inches.	Wind. Most frequent direction.	Cloud. At 10 A.M.	Cloud. At 4 P.M.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	°	°	°	°	°	°					
1896.																	
October	27·818	27·597	27·739	27·722	27·533	27·644	42	35	89·3	52·8	70·8	48·1	1	0·00	Calm	1·6	1·4
November	27·909	27·673	27·787	27·815	27·570	27·691	52	44	80·5	47·2	62·5	44·5	3	0·44	,,	2·8	2·9
December	27·964	27·691	27·858	27·850	27·652	27·760	54	44	74·5	38·6	54·8	35·2	4	0·49	Calm & S.	1·7	2·2
1897.																	
January	27·969	27·613	27·802	27·859	27·560	27·708	68	54	73·1	40·6	55·4	39·0	10	2·44	S.W. Calm W. & N.W.	5·4	5·3
February	27·843	27·605	27·728	27·731	27·519	27·636	54	39	82·6	40·1	56·9	39·0	5	1·27	W.S.W. & Calm.	2·7	3·0
March	27·809	27·517	27·657	27·693	27·427	27·556	40	29	88·2	48·1	65·8	41·7	5	0·77	Calm S.W. & N.W.	4·5	4·9
April	27·763	27·492	27·643	27·641	27·368	27·545	30	19	103·4	54·0	76·6	48·8	4	0·77	W.	2·9	3·5
May	27·598	27·388	27·491	27·546	27·294	27·397	26	20	106·5	63·5	85·0	53·3	2	0·74	W.S.W. & N.	1·7	3·2
June	27·544	27·221	27·398	27·496	27·151	27·298	48	39	105·8	65·1	83·5	57·8	11	3·41	S.E., W. & N. W.	4·1	3·5
July	27·497	27·254	27·396	27·394	27·184	27·312	76	72	97·3	69·5	79·6	65·3	23	23·02	S. E. & N.W.	6·4	6·8
August	27·609	27·282	27·451	27·486	27·204	27·359	84	83	90·8	70·2	77·0	68·3	28	30·45	Calm & S. E.	8·6	8·7
September	27·715	27·407	27·570	27·618	27·325	27·480	77	74	88·8	67·1	76·3	64·0	13	9·29	Calm	4·6	5·8

TYPE-PRINTING SECTION.—As will be seen from the annexed statement, the greater part of the work done consisted in printing forms, professional and others, for the department, and in setting up the large number of headings, foot-notes, etc., required in the Drawing Section in connection with the publication of maps.

Statement of work done during 1896-97.

SPECIFICATION OF PRINT.	No. of pages.	Total No. of pulls.	No. of copies of each page.	VALUE.
				R
Professional volume	52	8,080	500	1,514
Synoptical volumes	66	7,440	350	1,917
Topographical Hand-Book (second edition)	50	6,810	400	1,055
Pamphlets of spirit-levelled heights	118	7,490	350	2,018
Letter-press for charts, map headings, foot-notes	266	6,700	...	2,728
Forms	268	88,850	...	5,878
Magnetic pamphlet	12	590	75	299
Miscellaneous	71	23,110	...	1,650
Extra-departmental work	160	4,190	...	145
	1,063*	153,260	...	17,204

* Equal to 1,110 pages of standard (foolscap) size.

The usual table showing the work annually performed by this section during the past five years is given below, the unit (a page of foolscap) being the same throughout:—

	1892-93.	1893-94.	1894-95.	1895-96.	1896-97.
Pages composed	2,195	1,638	1,219	1,135	1,110

An analysis of the pages composed in 1896-97 is as follows :—

PROFESSIONAL VOLUME	Tidal Volume	104
SYNOPTICAL VOLUME	Great Arc Meridional Series, Section 8° to 18° and Indus Delta Triangulation	97
MISCELLANEOUS	Spirit-levelled heights	118
	Letter-press for charts, maps, headings, foot-notes	160
	Forms, orders, memoranda, etc.	423
	Miscellaneous	40
	Extra-departmental work	99
	Topographical Hand-Book	50
	Magnetic Pamphlet	19
	TOTAL	1,110

PHOTO-ZINCOGRAPHIC SECTION.—In August and September, a great deal of extra work was thrown on this section owing to the heavy demand for maps for the frontier expeditions. As the demand was urgent, the whole strength of the section was devoted to this work, and by working overtime 8,846 pulls were made in twelve days.

The following tables exhibit the value and outturn of the work done by this section :—

Abstract of Departmental work done during the year 1896-97.

Specification.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic Printing.							Silver and other Printing.		Value.
			Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Pulls.	Number of copies.			Silver prints.	Blue and other prints.	
							Coloured.	Uncoloured.	Total.			
												R a.
Standard maps . . .	162	219	315	145	179	23,890	6,143	11,526	17,669	2	...	9,989 3
Index maps . . .	8	2	7	5	5	1,690	570	575	1,145	...	...	169 0
Technical charts . .	16	15	30	27	17	8,446	1,810	301	2,111	...	7	807 15
Miscellaneous maps and plans.	197	75	85	33	45	5,666	1,610	3,627	5,237	12	133	2,639 7
Transfers and proofs . .	...	...	...	...	...	918	...	...	...	...	...	...
Totals .	383	311	437	210	246	40,610	10,133	16,029	26,162	14	140	13,605 9

Statement of work done for other departments, etc., during the year 1896-97.

Departments, etc.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic Printing.							Silver and other Printing.		Value.
			Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Pulls.	Number of copies.			Silver prints.	Blue and other prints.	
							Coloured.	Uncoloured.	Total.			
												R a.
Forest Survey . . .	135	227	240	139	136	16,237	1,280	11,797	13,077	...	...	6,662 11
Quarter Master General .	2	...	...	...	...	8	...	8	8	...	...	8 8
Military Department . .	1	1	1	1	1	35	...	35	35	...	...	23 12
Other Departments . .	3	1	...	2	2	200	...	115	115	...	15	43 12
Totals .	141	229	241	142	139	16,480	1,280	11,955	13,235	...	15	6,738 11

Table showing the amount realized from other departments, etc., by book debit and cash sales during 1896-97.

Departments, etc.	By book debit.	By cash sales.	Total.
	R a.	R a.	R a.
Forest Department	......	171 6	171 6
Forest Survey	7,082 1	104 9	7,186 10
Quarter Master General	2,554 6	96 0	2,650 6
Military Department	112 6	400 6	512 12
Other Departments	187 12	344 15	532 11
Private individuals	......	201 15	201 15
Totals . .	9,936 9	1,319 3	11,255 12

CORRESPONDENCE SECTION.—The work in this section has been carried on as usual.

STORES, WORKSHOPS AND OBSERVATORIES SECTION.—Equipments for the Survey Detachments to accompany the Tochi, Malakand and Mohmand Field Forces and the Tirah Expeditionary Field Force were packed and despatched. In the observatories, the usual time observations were taken, the chronometers rated and kept in order, and other miscellaneous work done, including the magnetic observations already mentioned.

SOLAR PHOTOGRAPHIC SECTION.—The usual wet plate process was employed for taking Solar negatives, but experiments were also commenced in using dry plates—Cadett's and Thomas' Lantern plates, such as are employed at Greenwich.

Their use is a great advantage in the rainy season when the glimpses of the sun are short and uncertain, but the results are not so clear and good as those by the wet collodion process. It will however be always advisable to have some in hand for use during the rains.

The details of the work of this section are given below:—

Table showing the number and character of negatives.

1896-97.	Number of days.				Number of negatives.										Number of working days when phenomena were	
	When negatives were taken.	Failures.			Solar Phenomena.								Total.		Visible.	Absent.
		From bad weather.	From various causes.	Total.	Spots and faculæ.		Spots only.		Faculæ only.		None.					
					8"	12"	8"	12"	8"	12"	8"	12"	8"	12"		
October . .	31	...	...	31	50	...	...	...	5	...	...	...	55	...	31	...
November . .	27	3	...	30	47	...	...	...	...	...	...	...	47	...	27	...
December . .	29	2	...	31	54	...	...	...	...	...	...	...	54	...	29	...
January .	21	10	...	31	39	...	...	...	...	...	...	...	39	...	21	...
February . .	24	4	...	28	43	...	...	...	...	...	...	...	43	...	24	...
March . .	28	3	...	31	50	...	...	...	...	...	...	...	50	...	28	...
April . .	28	2	...	30	45	...	...	...	4	...	...	...	49	...	28	...
May . . .	30	1	...	31	42	...	...	...	13	...	...	...	55	...	30	...
June . . .	30	...	...	30	39	...	...	...	15	..	...	...	54	...	30	...
July . . .	21	10	...	31	31	...	...	...	...	...	...	...	31	...	21	...
August . .	20	11	...	31	31	...	...	...	...	...	...	...	31	...	20	...
September .	27	3	...	30	45	...	...	...	...	...	...	...	45	...	27	...
TOTAL .	316	49	...	365	516	...	...	...	37	...	...	...	553	...	316	...

Five hundred and fifty-three silver prints of the 8-inch pictures were prepared, and weekly despatches of both silver prints and negatives made as usual to the India Office.

Table showing the visibility of Sun at Dehra Dún and Greenwich.

Year.	At Dehra Dún.			At Greenwich.		Remarks.
	Number of days on which negatives were taken.	Percentage of days on which negatives showed features.	Number of days on which sun was invisible.	Year.	Number of days on which negatives were taken.	
1880-81*	307	96	55	1880	156	*From 1st October to 30th September following.
1881-82	328	100	37	1881	181	
1882-83	318	100	47	1882	221	
1883-84	285	100	78	1883	215	
1884-85	284	100	81	1884	154	
1885-86	290	100	75	1885	206	
1886-87	302	98	61	1886	199	
1887-88	328	91	38	1887	188	
1888-89	315	71	50	1887-88	205	
1889-90	320	78	45	1888-89	182	
1890-91	303	99	62	1889-90	212	
1891-92	304	100	62	1890-91	224	
1892-93	292	100	73	1891-92	219	
1893-94	304	100	61	1892-93	220	
1894-95	313	100	52	1893-94†	230	†Year ending 10th May 1894 obtained from the report to the Board of Visitors.
1895-96	324	100	41	1894-95	Not obtainable.	
1896-97	316	100	49	1895-96		
Mean .	308	...	57	...	201	

Synopsis of the results of the Monthly Magnetic Observations taken at the Trigonometrical Branch Office, Dehra Dún. The measures of Intensity are all expressed in C. G. S. units.

Year and Month.	Magnetic Elements. Declination East.			Horizontal Intensity.	Dip North.		Total Intensity.	Remarks.
	°	′	″		°	′		
1867								With unifilar magnetometer No. 17 and Dip circle No. 44.
January	2	54	12	0·33604	41	27·6	0·44839	
June		...		·33619		30·3	·44891	
July		...		·33561		31·2	·44824	
August		...		·33593		26·1	·44808	
September		...		·33582		29·5	·44833	
October		...		·33600		27·3	·44831	
November	3	3	17	·33639		29·7	·44912	
December		...		·33634		28·9	·44896	
1868								
January	3	2	14	0·33634	41	27·4	0·44878	
February		...		·33635		27·1	·44875	
March		...		·33656		25·2	·44882	
April		...		·33573		30·0	·44826	
May		...		·33569		33·0	·44856	With unifilar magnetometer. No. 16 and Dip circle No. 43.
June		...		·33614		29·3	·44873	
July		...		·33685		34·0	·45023	
August		...		·33625		28·7	·44880	
September	3	3	4	·33608		32·5	·44901	
October	3	2	13	·33551		30·0	·44796	
November		...		·33632		30·9	·44915	
December		...		·33616		35·0	·44942	
1869								
January		...		0·33643	41	32·2	0·44946	
February		...		·33636		31·3	·44925	
March		...		·33621		28·1	·44868	
September	3	5	10	·33466		35·4	·44746	
November	3	6	44	·33644		32·1	·44946	
1897								
January	2	49	39	0·33659	42	40·2	0·45778	
February	2	48	42	·33730		42·1	·45898	
April	2	48	17	·31901*		41·0	·43396*	
May	2	50	4	·33667		46·5	·45866	With unifilar magnetometer No. 19 and Dip circle No. 43.
June	2	48	15	·34032		50·5	·46413	
July	2	48	42	·33646		38·8	·45743	
August	2	45	22*	·33656		45·6	·45840	
September	2	48	10	·33695		45·2	·45888	

Observations unsatisfactory.

DRAWING SECTION.—The details of the work done in this section are given in the tables which follow :—

Statement showing the work performed during 1896-97.

TITLE OF MAP.	Number of sheets.	Scale.	REMARKS.
General Maps.		In. M.	
Map of portion of Tibet explored by Captain H. H. P. Deasy, 16th Lancers, in 1896	2	1=8	Completed. Final press order given.
Standard Maps.			
Dehra Dún and Siwáliks, sheets Nos. 1, 2 and 3	3	1=1	Corrections for 2nd edition. In hand.
Level sheets, Nos. 67, 74 and 88	3	1=2	Compilation in hand.
Punjab Survey, sheets Nos. 246 N. E., 264 S. E., 265 S. E., 285 S. W., and 286 N. W.	20	$1=\frac{1}{3}$	Corrections completed for reduction to half scale. Final press order given.
Punjab Survey, sheets Nos. 264 N. E., 265 N. W., 265 S. W., 286 S. W., 308 N. W., 313 N. W., 313 S. W., and 336 N. W.	32	$1=\frac{1}{2}$	Corrections for reduction to half scale in hand.
Plans of Cities and Cantonments.			
Dehra Dún Municipality and Cantonment (2nd edition)	3	$1=\frac{1}{12}$	Completed. Final press order given.
Simla Revisionary Survey, sheets Nos. 1, 2, 3, 4, 5, 6, 7 and 8	8	$1=\frac{1}{16}$	Completed for reduction to two-thirds scale. Final press order given.
Mussooree and Landour Guide Map	1	$1=\frac{1}{8}$	Completed additions and corrections to 1896. Final press order given.
Index Maps.			
Triangulation Chart of India	1	1=96	Brought up to date for Annual Report.
Index to illustrate survey operations by No. 18 Party in the Himálayas	1	1=20	Ditto ditto
Index to illustrate survey operations by No. 14 Party in districts Damoh, Biláspur and Sambalpur	3	Various	Ditto ditto
Index to the Charts of the Principal Triangulation of the Makrán Longitudinal Series	1	1=48	Completed for reduction to half scale. Final press order given.
Charts.			
Triangulation Chart of Great Arc Series, Sections 8° to 18°	4	1=4	In hand.
Nos. 43 and 44, Preliminary Charts of Indus Delta Coast Triangulation	2	1=4	In hand.
Chart of Triangulation, sheets Nos. 61, 62, 65, 66, 81 and 85 (Central Provinces)	6	1=2	Completed headings and foot notes. Final press order given.
Chart of Triangulation of Punjab Survey, sheets Nos. 311, 314 and 336	3	1=2	Ditto ditto.
Spirit-levelling operations No 7, Bombay Presidency (revised edition)	1	1=8	Corrections completed for reduction to half scale. Final press order given.
Miscellaneous.			
Tidal maps of Colombo, Madras and False Point	3	Various	Completed. Final press order given.
Tidal maps of Tuticorin, Galle, Amherst, Minicoy, Rangoon, Pámban Pass, Bombay, Dublat, Hanstal and Diamond Harbour	10	Various	In hand.
Part of North-West Frontier (skeleton)	1	1=16	Completed. Final press order given.
Other maps	15	Various	Touched up for photography, and completed as regards headings and foot-notes. Final press order given.
Ditto	1	1=16	Completed. Final press order given.
Maps coloured	2,478	Various	

Statement showing the work performed during 1896-97.

MAPS EXAMINED.

	No. of Sheets.
Standard original maps	101
Charts	9
Miscellaneous maps	22
Photographic proofs of standard sheets and other maps	238
TOTAL	370

N.B.—In addition to the above, other miscellaneous duties have been performed, such as completing Central Provinces, Punjab Survey, Sind Survey Sheets and Spirit Levelling Operation Charts, etc., in respect of headings, foot-notes, symbols, etc., for press; taking out and checking areas of villages, their cultivation, forests, etc., of 14 Punjab Survey sheets; taking out areas of portions of Mussooree Settlement, and of the Dehra Dún Municipality for the Superintendent, Dehra Dún; examination of and custody of records; making all the despatches of maps, etc., etc., etc.

Statement of work done for other departments during 1896-97.

TITLE OF MAP.	Number of sheets.	Scale.	REMARKS.
		In. M.	
Standard Maps.			
Forest Surveys	114	1=¼	Completed headings, foot-notes and references. Final press order given for Forest Department.
Ditto	1	1=1	Ditto ditto.
Index Maps.			
Forest Surveys	6	Various	Ditto ditto.
Charts.			
Forest Surveys	1	1=1	Ditto ditto.

G. I. C. P. O.—No. 13 S. G.—97-98.—450.

1898.

File No. 66 of 1898.

Serial No. 2.

GOVERNMENT OF INDIA.

DEPARTMENT OF REVENUE AND AGRICULTURE.

LAND SURVEYS.

RESOLUTION.

No. 3—66—2.

Dated Simla, 17th August 1898.

SUBJECT.

Resolution on the operations of the Survey of India Department during the year 1896-97.

G. C. Press, Simla.—No. 510 R. & A. D.—19-8-98.—720.

Extract from the Proceedings of the Government of India, Department of Revenue and Agriculture, No. 3—66—2, dated the 17th August 1898.

READ—

The General Report on the operations of the Survey of India Department during the year 1896-97.

RESOLUTION.

The field operations of the Survey of India Department for the year ending 30th September 1897 were carried on by twenty-one parties and one detachment.

The various classes of work on which these parties and the detachment were engaged are shown below :—

	Number of parties employed.	Number of detachments employed.
1. Trigonometrical	1	...
2. Topographical	6	...
3. Traverse	2	...
4. Topographical and Traverse	1	...
5. Forests (excluding Forest Survey Branch)	5	...
6. Cadastral	3	1
7. Scientific	3	...
TOTAL ...	21	1

Thus ten whole parties, a portion of another party, and a detachment were employed on remunerative work connected with land and forest revenue, as compared with eleven parties and two detachments so employed in 1895-96.

2. The aggregate area surveyed on all scales during the year was 104,987 square miles, against 63,653 square miles in 1895-96, an increase of 41,334 square miles, due to the large amount of reconnaissance completed in Upper Burma and elsewhere.

3. The party employed on trigonometrical operations continued the principal triangulation of the Makrán Longitudinal Series from Kuliri and Piaro in Longitude 66° 30′ westwards over a direct distance of about 75 miles, comprising 3 figures and embracing an area of 1,380 square miles.

4. Topographical operations were carried on in Upper Burma, Sindh, Baluchistan and the Himalayas and also in portions of Assam, Burma, Bengal and the Punjab. The survey of the Layari quarter of Kurrachee on the scale of 80 feet = 1 inch was completed, while the large scale (48 inches = 1 mile) survey of the town of Nahan in the Punjab was begun. The total area topographically surveyed was 14,460 square miles against 19,798 square miles in the previous year. The decrease is due to the fact that the ½ inch survey of No. 15 Party was almost finished last year and consequently only 700 square miles were executed against 11,307 in that year.

5. Forest surveys were continued in the Central Provinces, the Bombay and Madras Presidencies and in Lower Burma.

In the Central Provinces the detail survey of the forests in the Damoh District was brought to a close, while operations were begun in the district of Bilaspur, and in the Bombay Presidency the 4-inch detail survey in the Poona District was completed. In the Madras Presidency the outturn of work was short, but this was due to the inexperience in topographical work of a traverse party transferred from the Central Provinces. In Lower Burma 395 square miles on the 4-inch scale and 106 square miles on the 2-inch scale were completed in the Toungoo District. The Himalaya Party also surveyed an area of 191 square miles on the 4-inch scale in Sirmur, Patiala, Kullu and Kangra. The Forest Survey Branch continued operations in the Central Provinces, the Punjab and Burma and in addition started a new survey in the Ruby Mines District. The outturn of work for the past two years is given below :—

	1895-96.	1896-97.
(1) Imperial Parties	3,202	3,260
(2) Forest Survey Branch	1,712	1,563

The decrease under (2) is not explained.

The cost rate in the Central Provinces has been reduced, whilst for Bombay and Lower Burma there is a slight increase. In Madras the increase has been considerable, but this was due to exceptional circumstances which are fully explained in the report.

6. Cadastral operations by Imperial parties were carried on by one party and one detachment in Bengal, one party in Upper Burma, one party in Lower Burma and by local agency in the North-Western Provinces and Oudh under the general superintendence of the Deputy Surveyor-General, Revenue Branch. Owing to the famine it was found necessary to modify the programme in Bengal. In Burma the survey of the Town of Rangoon was completed. The local agency in the North-Western Provinces and Oudh completed the survey and record writing of the Meerut District and of the Lalitpur Subdivision. The total area surveyed in the different Provinces amounted to 7,190 square miles, of which 4,225 square miles in the North-Western Provinces and Oudh were executed by local agency. The decrease in the total area completed as compared with last year's return (8,609 square miles) is due to the curtailment of the programme in Bengal on account of famine and a similar curtailment in Burma, where survey operations had outstripped the settlement work.

7. Two parties were employed on traverse operations in the North-Western Provinces and Oudh and one party in Assam. The total area traversed during the year was 6,135 square miles compared with 9,089 square miles in the previous year. The decrease is apparently due to the reduction of the number of traverse parties from three to two during the year.

8. Observations were taken during the year for redetermining the value of the latitude of Madras and the result combined with a value obtained by Mr. Michie Smith, the Government Astronomer, Madras, aad two previous values gave a mean value for. Madras of 13° 4′ 8″ ·02 north latitude.

9. Tidal observations with self-registering tide gauges were continued by one party at twelve stations in India, Burma, the Persian Gulf, the Andaman Islands and the Red Sea. It is intended to discontinue the series of observations at Muscat and Bushire and to open new observatories at Perim, Porbandar and Port Albert Victor. Spirit-levelling was continued from Potanghi to Vizianagram and from Bilaspur to Katni within 150 miles of the terminus at Allahabad, giving a total outturn of 291½ miles of double levelling.

10. In Upper Burma an area of 11,718 square miles was geographically surveyed, while 2,000 square miles of triangulation were also completed. The aggregate areas geographically surveyed during the year on the Eastern and Western Frontiers amounted to 78,718 square miles.

11. The work done in the various head-quarters offices has been satisfactory. In the Drawing Section progress has been made in the completion of the maps of the North-Eastern and South-Eastern Frontiers. The general maps of India on various scales have received additions and corrections, and the second edition of the 32-mile map of India has as far as possible been brought up to date. A new canal map of India on the 32-mile scale and also a railway map of India on the 48-mile scale are in course of publication. The provincial maps on the 16-mile scale and 58 Atlas sheets have been revised, while 5,493 cadastral sheets have been prepared for publication.

12. In the Engraving Office the preparation of the quarter sheets of the Atlas of India was continued, and fourteen district maps for administration reports, the index to the standard sheets of the Bombay Presidency, a new weather chart and the provincial map on the 16-mile scale of Mysore and Coorg with hills were completed Progress was also made in the completion of the provincial maps of Bengal, Bombay, Madras, Assam, Central India Agency, Rajputana and Mysore (without hills).

13. In the Photographic and Lithographic Office the outturn of work was again satisfactory, and, though there was a slight falling off in the amount of work done for other Departments and the total value of the work, the number of original subjects dealt with showed a considerable increase. The progress made in the Heliogravure Section, more especially in the production of half tone and line blocks for machine printing, is very creditable. Arrangements were made by this office to obtain photographs of the corona at the solar total eclipse.

14. The total number of maps issued from the Map Record and Issue Office was 207,330 and the value Rs. 1,57,927, an increase of 6,914 in number and Rs. 51,225 in value over the figures of 1895-96.

15. There was a decrease of nearly a lakh of rupees in the value of instruments issued from the Mathematical Instrument Office, due mainly to a smaller demand on account of railways and other large works. The number of instruments rendered serviceable, however, showed an increase of 9,310 in number and Rs. 5,130 in value. The conversion of repairable instruments into serviceable ones has been the means of reducing the amount of the indents for instruments manufactured in England from over £13,000 in 1893-94 to less than £4,000 in 1897-98.

16. The Survey Training School established at Dehra in June 1896 for training surveyors in field work before being attached to survey parties has given satisfactory results.

17. The Survey of India Department continued throughout the year under the administration of Major-General Strahan, and the Government of India desire to acknowledge his efficient management of the Department and the value of the work done in all Branches.

ORDER.—Ordered that the above Resolution be forwarded to the Surveyor-General of India, the Inspector-General of Forests, the Local Governments and Administrations noted on the margin, and to the Foreign, Military and Public Works Departments.

Madras.
Bombay.
Bengal.
North-Western Provinces and Oudh.
Punjab.
Burma.
Central Provinces.
Assam.
Coorg.
Berar.

Ordered also that this Resolution be published in the Supplement to the *Gazette of India.*

[True Extract.]

T. W. HOLDERNESS,

Secretary to the Government of India.

GENERAL REPORT,

Survey of India Department,

1897-98.

Agents for the sale of Books published by the Superintendent of Government Printing, India, Calcutta.

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OCTAGONAL TOWER, ZÂHRA BÂGH, AGRA.

GENERAL REPORT

ON THE

OPERATIONS

OF THE

Survey of India Department

ADMINISTERED UNDER

THE GOVERNMENT OF INDIA

DURING

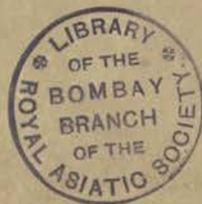
1897-98.

PREPARED UNDER THE DIRECTION OF

MAJOR-GENERAL C. STRAHAN, R.E.,

SURVEYOR-GENERAL OF INDIA.





CALCUTTA:
OFFICE OF THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.
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TO THE
GREAT TRIGONOMETRICAL SURVEY
OF
INDIA


TO ACCOMPANY SURVEYOR GENERAL'S REPORT FOR
INDIA
SHEWING THE PROGRESS OF THE IMPERIAL SURVEYS
To 1st October 1898.
BAY OF BENGAL
REFERENCES.
INDIAN OCEAN
No. 456-S. 99

GENERAL REPORT

ON THE

Operations of the Survey of India

DURING THE SURVEY YEAR

1897-98.

PART I.

SUMMARY.

ADMINISTRATION.

1. The operations of the department that are now reported on are for the survey year ending 30th September 1898.

2. The general administration of the department and the superintendence of the Topographical Branch remained throughout the year in the hands of Major-General C. Strahan, R.E., Surveyor-General of India. Colonel J. E. Sandeman, I.S.C., Deputy Surveyor-General, having been forced through ill health to take furlough during the preceding year, Major-General R. G. Woodthorpe, C.B., R.E., was appointed to officiate for him, but as he was himself out of health and on leave at the time, Lieutenant-Colonel J. R. Hobday, I.S.C., acted as Deputy Surveyor-General, and held charge of the Revenue Branch from the beginning of the year till 9th November 1897, when Major-General Woodthorpe returned and received charge. Notwithstanding his having remained in England for upwards of two years, he had not been able to shake off the malaria from which he had been suffering, and on the 26th May 1898 he died, and Lieutenant-Colonel Hobday again took up the duties of the Deputy Surveyor-General, in which appointment he was confirmed on the 3rd September 1898, when Colonel Sandeman's services were replaced at the disposal of the Military Department. Lieutenant-Colonel St. G. C. Gore, R.E., Superintendent, Trigonometrical Surveys, returned from privilege leave and resumed charge of his office from Captain G. P. Lenox-Conyngham, R.E., on the 20th October 1897. Colonel Gore, however, proceeded on special leave for six months on the 26th April 1898, when Major S. G. Burrard, R.E., was appointed to officiate for him. Captain R. T. Crichton, I.S.C., continued to be Superintendent, Settlement Surveys, Bengal, throughout the year.

Mr. G. B. Scott superintended all the cadastral operations in the North-Western Provinces under the title of Superintendent of Land Records Surveys.

Inspection Tours of the Administrative Officers.

3. The Surveyor-General left Calcutta on the 10th April and proceeded to Dehra, where he visited the Great Trigonometrical Office and training school. On the 17th April he arrived at Simla, where he remained till the 19th July, when he returned to Calcutta, again visiting the Trigonometrical Office at Dehra and the field parties recessing at Mussooree on his way back. During his stay at Simla he inspected the Drawing Office and the Office of No. 18 (Himálaya) Party. On the 18th September Major-General C. Strahan again left Calcutta and proceeded to Bangalore, where he inspected the recess offices of Nos. 9 and 19 Parties (Madras), and of Nos. 10, 11, 20 and 21 Parties (Burma). From Bangalore he went to Poona, where Nos. 17 and 25 Parties were inspected. Having been summoned to Simla to discuss the future of the Forest Survey Branch with the Secretary to Government in the Revenue and Agricultural Department and the Inspector-General of Forests, he proceeded there, arriving on the 10th October. He returned to Calcutta on the 1st November.

4. Major-General R. G. Woodthorpe, R.E., Officiating Deputy Surveyor-General, Revenue Branch, left Calcutta on the 19th November 1897 for Sylhet to assist the officer in charge in making field arrangements for No. 14 Party, which was about to enter the Lushai Hills for the first time, and he returned to Calcutta on the 29th idem. On the 10th December he started for Assam to inspect No. 6 Party in the field at Tezpur, and returned to Head-Quarters on 21st idem. On the 3rd of January 1898 he proceeded to inspect the Bengal survey parties in the field at Samastipur and Darbhanga till the 17th idem, when he left for Allahabad to confer with Mr. G. B. Scott, the Superintendent, Land Records Surveys, and the Board of Revenue in the North-Western Provinces and Oudh. After seeing some of the detachments at work in the field at Fatehgarh and Cawnpore, he returned to Calcutta on the 2nd February. On the 7th March he sailed for Rangoon to inspect Nos. 3, 7 and 20 Parties in the field in Burma and returned to Calcutta on the 28th April.

5. On the death of Major-General Woodthorpe, Lieutenant-Colonel J. R. Hobday was appointed Officiating Deputy Surveyor-General, Revenue Branch. He left Calcutta on the 24th of June to inspect Nos. 6 and 14 Parties at recess quarters in Shillong, returning to Head-Quarters on the 14th July. On the 11th August he sailed from Calcutta for Madras, and inspected Nos. 9 and 19 and 20 Parties at Bangalore, returning to Madras on the 25th idem, when he sailed for Rangoon to confer with the officers in charge of Nos. 3 and 7 (cadastral) Parties, regarding the conversion of the former into a topographical party for the next field season; he returned to Calcutta on the 9th September. On the 20th September he proceeded to Naini Tal to confer with the Superintendent, Land Records Surveys, in the North-Western Provinces and Oudh, and then to Mussooree to inspect Nos. 2 and 8 Parties and the Bengal Surveys at recess quarters, returning to Head-Quarters, Calcutta, on the 11th October. He again started for Darjeeling on the 13th October to confer with the Local Government about matters connected with the Bengal Surveys and returned to Calcutta on the 25th idem.

6. Major S. G. Burrard, R.E., Officiating Superintendent, Trigonometrical Surveys, visited Simla in August to inspect No. 18 Party, and shortly after his return to Dehra in September proceeded to Mussooree, where he inspected the offices of Nos. 22, 23 and 24, the Astronomical and Triangulation Parties.

In October, Major Burrard paid a visit of inspection to Karáchi to examine into the work of the Sind Survey Party (No. 12).

FIELD PARTIES.

7. The field operations of the year were carried on by two double and 17 ordinary parties. Of these, one party and one detachment were employed on trigonometrical surveys ; seven parties on topographical surveys ; one double and two ordinary parties on forest surveys ; three parties on cadastral surveys ; one double and one ordinary party on traverse surveys; and three parties on scientific operations. The operations of the Forest Survey Branch were continued during the year in addition to the above. The Land Records surveys carried on by local agency in the North-Western Provinces and Oudh, which are under the general superintendence of the Deputy Surveyor-General, Revenue Branch, have been included in this report under the head of Cadastral Surveys.

8. The following tabular statement shows the whole of these operations grouped according to the scope and nature of the work on which the parties were severally employed :—

Statement of Survey Operations and Parties.

No. of Party.	Nature and *locale* of operations.	Page in this Report.	Executive Officers.	Scale of Survey.	Administrative Superintendent.
	Trigonometrical Survey.				
24	Baluchistán . . .	17	Captain J. M. Burn, R.E. . Lieutenant H. H. Turner, R.E. Mr. J. Hickie . . .	......	Supdt., Trig.
Det. of 25	Assam	64	Mr. J. Bond . . .	......	Ditto.

Statement of Survey Operations and Parties—concld.

No. of Party.	Nature and *locale* of Operations.	Page in this Report.	Executive Officers.	Scale of Survey.	Administrative Superintendent.
	Topographical Surveys.				
6	Assam	56	Captain C. W. H. Symonds, I.S.C. Mr. W. H. Penrose	2″=1 mile for reduction.	D. S. G., Rev.
10	Upper Burma	18	Captain A. J. Pilcher, R.E. Lieutenant W. M. Coldstream, R.E. Lieutenant H. J. Hare, R.E.	1″=1 mile for reproduction.	Ditto, Topo.
11	Ditto	19	Captain T. F. B. Renny-Tailyour, R.E. Mr. P. J. W. Doran	Ditto	Ditto.
12	Sind	21	Mr. C. F. Erskine	2″=1 mile for reduction	Supdt., Trig.
14	Lushai	23	Major G. B. Hodgson, I.S.C. Mr. J. Keating	1″=1 mile for reproduction.	D. S. G., Topo.
15	Baluchistán	26	Colonel Sir T. H. Holdich, K.C.I.E., C.B., R.E. Lieutenant-Colonel R. A. Wahab, C.I.E., R.E. Lieutenant F. W. Pirrie, I.S.C. Mr. T. E. M. Claudius	6″=1 mile and 1″=1 mile for reproduction.	Ditto.
18	Himálayas	27	Lieutenant-Colonel R. A. Wahab, C.I.E., R.E. Mr. L. J. Pocock	4″=1 mile for reproduction and reduction to half scale, and 2″=1 mile for reproduction.	Supdt., Trig.
21	Upper Burma	20	Lieutenant H. J. Hare, R.E.	1″=1 mile for reproduction.	D. S. G., Topo.
	Forest Surveys.				
9 & 19	Madras	30	Captain H. A. Denholm Fraser, R.E. Mr. C. F. Hamer	4″=1 mile for reproduction.	D. S. G., Rev.
17	Bombay	32	Captain P. J. Gordon, I.S.C. Mr. C. E. Tapsell	16″=1 mile, 8″=1 mile and 4″=1 mile for reproduction.	Ditto, Topo.
20	Burma	34	Lieutenant A. H. B. Hume, R.E.	4″=1 mile and 2″=1 mile for reproduction.	Ditto, Rev.
	Forest Survey Branch.				
	Central Provinces	37	Mr. W. H. Reynolds	4″=1 mile for reproduction.	I. G., Forests.
	Punjab	38	Ditto		
	Burma	38	Ditto		
	North-Western Provinces	39	Ditto		
	Cadastral Surveys.				
3	Upper Burma	40	Mr. E. J. Jackson „ E. G. Little	16″=1 mile and 8″=1 mile.	D. S. G., Rev.
4	Bihar	44	Captain R. T. Crichton, I.S.C.	16″=1 mile	S. S. S., Bengal.
7	Lower Burma	49	Mr. B. G. Gilbert-Cooper „ T. E. M. Claudius „ W. C. Price	16″=1 mile	D. S. G., Rev.
Land Records Survey.	North-Western Provinces and Oudh.	52	Mr. G. B. Scott	16″=1 mile	Ditto.
	Traverse Surveys.				
2 & 8	North-Western Provinces and Oudh.	53	Mr. J. S. Pemberton	16″=1 mile (skeleton plots).	D. S. G., Rev.
6	Assam	56	Captain C. W. H. Symonds, I.S.C. Mr. W. H. Penrose	......	Ditto.
	Geodetic.				
22 23	India	59	Captain G. P. Lenox-Conyngham, R.E.	......	Supdt., Trig.
	Tidal and Levelling Operations.				
25	India	60	Major S. G. Burrard, R.E. Lieutenant H. L. Crosthwait, R.E. Mr. E. J. Connor	......	Supdt., Trig.

OUTTURN.

9. During the year under report the aggregate area surveyed on all scales amounts to 36,199 square miles, of which 9,976 square miles were reconnaissance only. The report of last year shows an area of 104,987 square miles; the decrease this year is due to the small amount of reconnaissance completed. The aggregate area of rigorous survey on all scales amounted to 26,223 square miles against 26,269 square miles of last year. These areas are exclusive of those embraced by the traverse operations in the North-Western Provinces and Oudh and Assam carried on for the purpose of furnishing a correct skeleton on which to base the field surveys under the Settlement Department; the area thus traversed during this year amounts to 5,128 square miles, whilst that of last year was 6,135 square miles.

10. The operations of the various Field Parties will be found summarized in the following paragraphs. A more detailed report on the operations of each Party for the year is given in Part II.

TRIGONOMETRICAL SURVEYS.

11. The triangulation party, to which had been allotted the work of continuing the Makrán Longitudinal Series westwards, took the field as usual. Shortly after arrival on the ground, when but little of the work had been completed, the serious disturbance in Makrán, which has formed the subject of special reports, took place, and the head-quarters of the survey party was attacked and completely looted, thirteen natives being killed. Captain Burn, who had been suffering from fever, was fortunately encamped on the top of a hill at a little distance from the main camp, and thus he and the men with him escaped with their lives, but with some difficulty and considerable hardships, as they were about 130 miles from the nearest European station. Four *khalásis* who were on detached duty were also killed, but the other officers and men, with the assistance of Mir Dura Khan and of Bibi Ganji Foh, escaped with the loss of part of their property. This brought the work to an abrupt conclusion, and the party was withdrawn to India as soon as feasible.

TOPOGRAPHICAL SURVEYS.

12. Seven parties have been employed during the year in this branch of the department, and triangulation in advance has been carried on by a detachment of No. 3 Party which has been engaged up till now in cadastral operations in Upper Burma, but which is to be turned into a topographical party from the coming field season. Three of these parties, *viz.*, Nos. 10, 11 and 21, have been employed in Burma, and the others, *viz.*, Nos. 12, 14, 15 and 18, in Sind, Lushai Hills, Balúchistán and the Himálayas, respectively.

13. The portions of country surveyed in Upper Burma by the three parties above named are all in the Shan States, and the aggregate area completed amounted to 7,282 square miles on the 1-inch scale and 1,752 square miles on the ¼-inch scale; 8,871 square miles were triangulated. The country surveyed in detail was mostly hilly and intricate and covered with tree or scrub jungle, which adds considerably to the difficulty of surveying and makes progress somewhat slow, so that the average outturn of 2,427 square miles per party is very satisfactory; the average cost rate of R18·4 is low considering the difficulties met with, such as the cost of carriage, the nature of the country and the high rates of pay necessarily given to surveyors working in Burma. Every effort is being made to train more sub-surveyors for these and for other topographical parties, so as to increase the area at a small increase to the cost, but it is a slow business, for sub-surveyors are not fit to work in such country under two or three years and the training school at Dehra cannot turn out many men each year; moreover, these men during the first year at actual work cannot be expected to turn out much area. Both officers and men are very liable to fever, which often shows itself in the early part of the recess season after the party has returned to Bangalore; there is no doubt that the complete change afforded by their recessing at such a place enables them in most cases to shake off the malaria contracted

during the cold weather and allows of their making a fresh start each season. Notwithstanding this, however, one officer, Lieutenant Coldstream, and one European assistant had to be invalided to England, and Major Longe, who originally took only six months' special leave, has had to apply for extension of one year, as he is unable to get out of his system the malaria which he has contracted in eight years of survey work in Burma.

No. 12 Party continued the survey of Sind on the 2-inch scale. The area completed amounted to 2,709 square miles at a cost of R14·6 per square mile. The area traversed amounted to 2,971 square miles at a cost rate of R10·1 per square mile. The traversing includes a survey of the village boundaries which are fixed by offsets. To meet the requirements of the Irrigation Department, a survey of certain lands in Kalát was carried on *pari passu* with the work in Sind. The area topographically surveyed amounted to 1,477 square miles on the 2-inch scale at a cost rate of R10·4 per square mile. The lines of traverse on which the detail work was based were so arranged as to include rectangular blocks of 5 miles by 2 miles, the corners of which were subsequently marked by embedding pieces of rail 5 feet in length; these will be used by the Irrigation Department as bench-marks. These traverse lines covered an area of 1,554 square miles and cost R8·9 per square mile.

The topographical survey of the Lushai Hills was commenced this season by No. 14 Party, and an area of 1,300 square miles was triangulated; in addition to this, a secondary series of triangles was started from one of the sides of the Eastern Frontier series near Silchar and carried southwards for a distance of about 100 miles; this will, during the coming field season, be connected with another base of the same series, and will thus give reliable bases on which to base the network of triangulation required by the detail surveyors. No detail survey was done, the party being little more than a detachment of a suitable strength to carry out the necessary triangulation in advance. This country presents numerous and serious difficulties to a surveyor; it is a mass of hills, all covered with dense forest or with long grass and bamboos, except where patches have been cleared for cultivation; thus every hill top selected for a trigonometrical station took several days hard work to clear. In addition to this, the inhabitants are but few and of those few every available man was being employed on road making. No baggage animals are of much use in such a country, so it was necessary to import 350 coolies for the carriage of the baggage; of these, 200, chiefly Nepálese, were from Darjeeling and the remainder from Cachar; the former turned out well, but the Cacharis gave a great deal of trouble and eventually they had to be discharged, and 60 Nágás and Kúkis were engaged in their place. In future all the coolies will be imported from Darjeeling. Another difficulty consisted in rationing the men; rice is the only grain obtainable locally and that only in limited quantities; the bulk of the food supplies was obtained from the Government contractor and then only at high prices. The climate is also unhealthy, as is evidenced by the amount of malarial fever, dysentery and rheumatism amongst the *khalásis* and coolies; there were also a good many cases of mild scurvy, due to the want of fresh meat and vegetables. It is evident that it will be impossible ever to employ a large survey party in these hills; progress will therefore be slow, and the cost rate high, but this is unavoidable.

No. 15 Party was employed on various surveys required by the Military Department and a detachment continued the topographical survey of the hilly country in the western portion of Sind, where an area of 1,857 square miles was completed on the 1-inch scale.

No. 18, the Himálaya Party, completed a total area of 576 square miles, of which 317 square miles were surveyed on the 4-inch scale and 259 square miles on the 2-inch scale. The 2-inch work consists of topography in Mandi, Suket and Simla Hill States, and in Sirmúr; and the 4-inch in Kángra, Kullu and Sirmúr. The large scale (48 inches=1 mile) survey of the town of Náhan was continued Classification of forest growth and soils was carried out over all the tracts in British territory that came under survey, as also in all the special forest surveys.

14. The areas topographically surveyed on various scales during the year amount to 15,109 square miles against 14,460 square miles executed last year.

The total is made up as follows :—

9,339	square	miles	surveyed	on	the	1-inch scale.
5,451	"	"	"	"		2-inch "
171	"	"	"	"		4-inch "
114	"	"	"	"		6-inch "
34	"	"	"	"		16-inch "

FOREST SURVEYS.

15. The special surveys of reserved forests on various scales are made partly by parties of the Survey Department and partly by detachments under Mr. Reynolds, the Superintendent of Forest Surveys. It is contemplated on Mr. Reynolds' retirement, which will take place in September 1899, to appoint an Imperial officer of this department as Superintendent of all Forest Surveys, and thus bring them all more under the professional control of the Surveyor-General. Survey operations were conducted this year in Madras, Bombay and Burma by the Imperial Survey parties, and in the Central Provinces, the Punjab and Burma by the detachments of the Forest Survey Branch. Small areas were also surveyed by the Imperial party working in the Himálayas.

16. In Madras two full parties were employed under the superintendence of one Imperial officer with an Assistant Superintendent. The expected increase in area of detail survey completed has unfortunately not been realised owing to the exceedingly intricate nature of the country, the unusually wet weather experienced at the beginning of the season, the amount of sickness, especially in the native establishments and also to the new hands, who joined the year before, being still unable to make much progress in such an excessively difficult country. An area of 1,050 square miles was surveyed on the 4-inch scale in the Salem, South Arcot, North Coimbatore and Kurnool districts and 1,620 square miles of triangulation in advance were completed in Kurnool and in Cuddapah.

17. In Bombay work is carried on on three different scales, the 4-inch for ordinary forest reserves, the 8-inch for special teak reserves and the 16-inch for small areas of *bábul* reserves. The areas completed on the various scales were as follows : in the districts of North Kánara 444 square miles on the 4-inch ; in Thána, Násik and Kolába 204 square miles on the 8-inch ; and 29 square miles on the 16-inch scale in Ahmednagar and Násik. The cost rate of the 4-inch work is less than that of last year, whilst the 16-inch is almost exactly the same ; the cost of the 8-inch work, however, is more, owing partly to the difficult nature of the country in Násik and Kolába, but mainly to the death of several trained men and experienced surveyors from plague since last field season.

18. The outturn in Lower Burma consisted of 406 square miles on the 4-inch scale in the Pegu and Shwegyin divisions and 118 square miles on the 2-inch scale on the Yenwe river adjoining the latter. The areas on both scales are slightly in excess of those of last year, but the cost rate is higher owing to the increase of the number of native surveyors from 36 last year to 55 this year ; until the new hands are properly trained, they add to the cost of the party without adding to the area surveyed, or at all events to only a very limited extent. In Pegu the men suffered much from fever ; one assistant was ill nearly all the season, whilst two sub-surveyors were discharged as physically unfit and four others were invalided, one of whom subsequently died. No less than twenty of the menial establishment died, two of whom were carried off by tigers ; the presence of these man-eaters caused a scare amongst the surveyors and quite disorganised the postal runners. It is intended to place this party under the Superintendent of the Forest Survey Branch, so that all surveys in the Bengal Presidency, including Burma, shall be under one superintending officer ; it will be a preliminary step to the proposed absorption of the Forest Survey Branch into the Survey Department.

19. An area of 146 square miles in Sirmúr, Kullu and Kángra were completed by the party working in the Himálayas.

20. The Forest Survey Branch continued its operations of last year. In the Central Provinces an area of 1,138 square miles was surveyed on the 4-inch and 16-inch scales, in the Punjab 200 square miles on the 1-inch and 52 square miles on the 4-inch scale, and in Burma 470 square miles on the 4-inch scale were completed. In the Salween Ataran forests the work was much disturbed

by the presence of Siamese dacoits in the near neighbourhood; one elephant was actually stolen and has not yet been recovered, whilst several unsuccessful attempts were made to carry off a second.

21. The total outturn of forest surveys executed on various scales during the year amounts to 4,132 square miles, of which 1,735 were surveyed by the Forest Survey Branch. The area surveyed by the Imperial Survey parties amounts to 2,397 square miles against 3,260 square miles executed last year. The decrease is due to No. 14 Party, which was hitherto employed on forest surveys having been converted into a topographical party.

The areas on the different scales are as follows:—

118	square miles	surveyed on the	2-inch	scale.
3,545	"	"	4-inch	"
204	"	"	8-inch	"
265	"	"	16-inch	"

CADASTRAL SURVEYS.

22. There were two parties in Burma administered directly by the Deputy Surveyor-General, one in Bengal composed of several detachments by the Superintendent of Settlement Surveys and one in the North-Western Provinces working by detachments in seven districts under the Superintendent of Land Records Surveys; the two latter are under the general professional superintendence of the Deputy Surveyor-General, whilst the programme and cost of operations are entirely under the control of the Local Governments.

23. The two parties in Burma were working, the one in Upper and the other in Lower Burma; the former continued the survey of the district Myingyan and completed the survey of Minbu; the detail survey of the Lower Chindwin district was commenced and a small area in scattered portions was surveyed in Katha. Traverse operations in advance were carried on in Lower Chindwin. The total area of each operation amounted to 1,466 square miles of cadastral on the 16-inch scale and 816 square miles of traverse survey. No writing of records is done by the Survey Department in Burma. Orders having been issued that this party should be converted into a topographical party and commence operations in Lower Burma next field season, an area of 2,345 square miles of advance triangulation was completed in the neighbourhood of Prome. The survey of the remaining areas in Upper Burma will be made by the party at present working in Lower Burma.

This latter party completed the traversing of the Toungoo district covering an area of 893 square miles and also surveyed 770 square miles of detailed survey on the 16-inch scale. In addition to this, the fair mapping and records of the Rangoon Town Survey were completed and a special survey of the Rangoon Sadar Bazár was made on the scale of 50 feet to the inch at the request of the Cantonment authorities.

24. The programme of surveys in Bengal was a varied one; it consisted of traverse, cadastral and topographical operations in Sáran, of traverse and cadastral surveys in Darbhanga and the cadastral survey of a small area in Noákháli; in addition to this, small areas were completed in various districts. The redemarcation of the greater part of the boundary between Nepál and districts Purnea and Bhágalpur was also made by this party. The following is a summary of the larger portions of the work completed together with the cost rates:—

In Sáran 555 square miles of cadastral and 27 square miles of topographical survey, both on the 16-inch scale, were completed, the former at a cost of R85·89 and the latter of R26·36 per square mile; the writing of records cost R104·29 per square mile; these rates are very much less than those of last year, as was anticipated. The area topographically surveyed represents the *diára* lands or lands subject to inundation by rivers where field boundaries are liable to be obliterated every year and where an expensive cadastral survey would be useless.

In Darbhanga no topographical survey was required, but an area of 733 square miles was cadastrally surveyed, 598 square miles were traversed; the cost rate of the cadastral operations was R74·86 and of writing the records R78·32 per square mile. A great deal of extra labour is thrown on this party from the excessive detail in the village sites which necessitates these

portions being surveyed on the scale of 64 inches to the mile; the average size of the field is also very small, less than half an acre in Darbhanga and not even one-third of an acre in Sáran. In these districts the attitude of the inhabitants is indifferent whilst the survey is going on, but great keenness is shown in watching the operation of writing the records.

In Noákháli two *chars* (recently-formed islands in the delta) to the east of the island of Sandip were surveyed, the area amounted to about 10 square miles; this small area had been left incomplete from last survey operations owing to exceptional difficulties.

The total amount of cadastral survey completed in Bengal consisted of 1,300 square miles.

25. The cadastral survey and writing of records were continued in the North-Western Provinces.

In Meerut and Lalitpur the records were completed, whilst in Sháhjahánpur and Bahraich the survey and writing of records were both finished; in Bijnor, Bareilly, Kheri and Gonda part of the field survey and records were accounted for. The total area surveyed during the past year is 3,440 square miles, whilst the total area of which survey and record writing has been completed since 1894 covers 7,165 square miles at an average cost, including superintendence and cost of instruments, but excluding traverse which is undertaken by Nos. 2 and 8 parties, of R58-13-7 per square mile.

26. A survey on the 64-inch scale of the cultivated lands in the Naini Tal district, which was just commenced last year, was continued and an area of 64 square miles were completed, leaving a little over 30 square miles for next season; according to the previous records, only a little over 50 square miles were said to exist. The actual cost rate for survey and record writing is R360-11-0 per square mile.

27. The total areas cadastrally surveyed during the year in the different provinces are as follows:—

	Square miles.
Bengal	1,300
Burma	2,236
North-Western Provinces and Oudh	3,440
	6,976

TRAVERSE SURVEYS.

28. The two parties which were occupied in making the traverse surveys in advance of the cadastral operations in the North-Western Provinces and Oudh during last season were this year amalgamated into one double party, partly to reduce the cost of superintendence and partly because the two complete parties turned out more work than was required by the Land Records Department. It is probable that eventually they will be entirely under the control of the Superintendent of the Land Records Surveys, as has always been the case in Bengal, and will not form a separate establishment as at present. Another party was employed in Assam in traversing and surveying on the 2-inch scale the gaps existing between previous cadastral surveys and the banks and channels of the Brahmaputra river; this party also located and traversed the boundaries of tea grants and of villages which had been cadastrally surveyed by local agency as well as those which remain for survey in the Assam Valley and certain villages and waste land grants in Sylhet and Cachar; thus its work was much scattered.

29. In the North-Western Provinces and Oudh an area of 3,851 square miles was completed in the districts of Farrukhabad, Pilibhít, Gonda, Kheri and Azamgarh. In connection with this traverse party is a detachment whose duty it is to survey topographically on the 2-inch scale the gaps left between the areas which have been surveyed cadastrally; its work was confined to the Lalitpur sub-division of the Jhánsi district and comprised an area of 104 square miles.

30. In Assam the following areas were completed:—

In the Assam Valley 902 square miles of 2-inch topographical survey and 195 square miles of traverse;

In Sylhet and Cachar 177 square miles of traverse and a survey of the Cherra Poonjee coal mines on the 32-inch scale was also completed; this did not complete the programme of the party as had been anticipated, and it has been decided to retain it for yet another year.

31. The areas traversed during the year, not including the traversing done by the cadastral parties for their own surveys, are as follows :—

	Square miles.
North-Western Provinces and Oudh	3,851
Assam	1,277
TOTAL	5,128

SPECIAL OPERATIONS.

32. The system of determining latitudes by observing at groups of stations close together instead of at a single station, was again given a trial; it had been originated by Lieutenant J. Herschel, R.E., some years ago, but had been allowed to drop, because that officer was removed from the work before he had fully elaborated the system. The Agra longitudinal station was selected as the central point, but for reasons which had not been foreseen it was found impossible to connect the outlying stations by a sufficiently rigorous triangulation for a proper comparison of the observed and computed azimuths; the latitude observations, however, led to interesting results, and there is good reason to believe that in more favourable country the system will prove highly valuable.

33. The tidal observations have been continued as usual. Observations with the self-registering tide-gauges have been made at 13 stations in India, Burma, the Persian Gulf, the Andaman Islands and the Red Sea. During the year the observatory at Muscat was closed. It is not intended to close any observatories during the ensuing year, but, if possible, the observatory at Port Albert Victor will be opened.

In addition to the automatic registering made during the year, personal tidal observations to graduated staves were taken at six stations to compare the actual times and heights of high and low water with those predicted in the tide tables.

34. In addition to the above which form part of the annual programme of the department, a revision of the principal triangulation in the Khási and Gáro Hills was undertaken, with a view to ascertaining what displacement vertically or horizontally had taken place during the earthquake of June 1897. No instrument of equal calibre to that employed in the original work was available, moreover it did not seem advisable to organise a fully equipped triangulation detachment in the first instance, as there was no certainty that any appreciable changes had actually occurred; the object was mainly to see whether such changes had taken place, so as to judge of the desirability of taking really accurate observations hereafter to determine the amount and area of the displacement. The detachment employed was the levelling section of the tidal and levelling party, and the instrument used was a 7-inch micrometer theodolite. Horizontal and vertical observations were taken at 13 stations, fixing the positions of 22 and the heights of 25 old stations, embracing an area of 1,020 square miles. The results show that the whole lay within the area affected by the earthquake, so it is impossible to say how much any one station has been displaced in comparison with the unaffected area outside, but apparently all have suffered more or less. The average horizontal displacement appears to be about 7 feet, whilst the changes in height vary from a subsidence of 4·3 feet to an upheaval of 24 feet; these, however, for the reasons given above cannot be considered as absolute but only relative changes. The general apparent effect is that the area has been both widened and raised. It is a question for consideration as to whether this revision work should be continued with a small instrument or whether it should be rigorously executed with the best possible theodolite, or indeed whether it should be proceeded with at all. As a matter of scientific interest it should be rigorously executed, as it is believed to be almost, if not quite, the only opportunity that has ever occurred of the possibility of actually measuring the movement of the earth's crust due to a large earthquake.

35. This department assisted to a considerable extent in the observation of the total eclipse of the sun which occurred on January 22nd, 1898. A detachment under Mr. Pope, the Assistant Surveyor-General in charge of the Photographic and Lithographic Offices was equipped with an equatorial camera which was erected at Dumráon. An excellent picture of the corona was obtained, as will be seen from the heliogravured copy of it which forms the frontispiece of last year's report. Mr. Pope deserves much credit for the excellent results he obtained. The camp at Sahdol where the Astronomer Royal and Professor Turner erected their instruments was managed by Major Burrard, R.E., assisted by Lieutenant Crosthwait, R.E., whilst that at Pulgáon where Mr. and Mrs. H. F. Newall and Captain and Mrs. E. H. Hills, R.E., made their observations was under the charge of Captain Lenox-Conyingham, R.E. In both cases all the arrangements were most satisfactory. In addition to the above, the services of Mr. Turner of the Photographic Office were lent to Sir Norman Lockyer, who expressed himself as well satisfied with the help he rendered him.

36. A magnetic survey of India is under consideration, and it is believed that a detachment under a Royal Engineer Officer will be formed some time next year to undertake the same.

GEOGRAPHICAL SURVEYS AND RECONNAISSANCES.

37. In Upper Burma an area of 1,752 square miles of new country was geographically surveyed on the ¼ inch scale by No. 21 Party.

38. The aggregate area geographically surveyed during the year on the eastern and western frontiers amounts to 9,976 square miles.

HEAD-QUARTERS OFFICES.

39. The details of the work done at the various offices at the head-quarters will be found in Part III of this Report.

40. The offices located in Calcutta were, as usual, in charge of three Assistant Surveyor-Generals. The Drawing, Engraving and Map Record and Issue Offices, as well as the Bengal Provincial Drawing Office, remained in the hands of Mr. A. E. Spring. The Photographic and Lithographic Offices remained under the supervision of Mr. T. A. Pope. The Correspondence and Mathematical Instrument Offices were in the hands of Major F. B. Longe, R.E., up to 9th November 1897, under Lieutenant-Colonel J. R. Hobday, I. S. C., up to 12th June, under Major W. J. Bythell, R.E., up to 6th August, and under Captain H. A. D. Fraser, R.E., up to the close of the year.

41. The Geographical Section of the Drawing Office has, as usual, been employed on the work of completing and keeping up to date the maps of the North-Eastern and South-Eastern Frontiers. Sheets Nos. 15 N. E. (3rd edition), 23 N. W. (8th edition), and 23 S. E. (2nd edition), on the 4-mile scale were brought up to date and published, and sheets Nos. 23 S. W. (8th edition) and parts of sheet 23 (N. E. and N. W.) on the same scale were corrected and brought up to date. Sheet No. 15 (4th edition) on the 8-mile scale was brought up to date and published. Sheets Nos. 1, 2, 3, 4, 5, 6 and 8 of the South-Eastern Frontier series were added to, corrected, and brought up to date, and the following on the 4-mile scale published, *viz.*, Nos. 1 N. E, 1 N. W, 2 S. E, 2 N. W., 2 S. W., and 5 N. W., and sheet No. 1 on the 8-mile scale was republished. Sheet No. 306 of Upper Burma on the 1-mile scale was brought up to date and published, and sheets Nos. 314 and 359 of the same series were published. Sheet No. 260 (2nd edition) is now under publication. The general maps of India on various scales have been added to, corrected, and brought up to date; the 3rd edition of the map of India on the 32-mile scale was completed and sent to the Lithographic office; a new canal map and railway map on the same scale were also published. A new railway map of India on the 32-mile scale showing railway and steamer stations was also put in hand, and is nearing completion; another map on the same scale was prepared for the Military Department showing railways on different gauges, canals and hills in grey; this map is now at press, being lithographed, and will probably be published during the ensuing year. The provincial map of Bengal, Bihar and Orissa on the 16-mile scale had the hills brush-shaded and sent for engraving. The

map of the Madras Presidency was compiled from materials furnished by the Local Government. The divisional map of Tenasserim was brought up to date and published, and seventeen district maps were revised and brought up to date. A large number of sheets of the atlas have, as in previous years, been dealt with ; seventy-seven have been corrected and brought up to date, and eight have had the hills brush-shaded and sent for engraving. A large number of maps were prepared in connection with the Famine reports of Bengal and Central Provinces, and also for the Military and other Departments.

42. The work of the Revenue Section has been mainly of the usual routine nature. A third edition of the map of Calcutta and surrounding country on the scale of 1 inch=1 mile has been prepared in three sections : one section embracing the northern portion has been compiled, the two southern sections have been passed through press with additions. The map of "City of Calcutta" (in two sections) on the scale of 6 inches=1 mile is being recompiled. Four standard sheets of district Peshâwar, a map of Naihâti municipality on the scale of 4 inches=1 mile, and a map of Narhan Estates (district Monghyr) on the scale of 1 inch=1 mile have been compiled, and one standard sheet of district Montgomery has been recompiled. The drawing of 14 standard sheets on the 2-inch scale of district Tavoy has been completed. In the North-Western Provinces and Oudh series, ten (old) sheets in 40 sections on the scale of 2 inches=1 mile, previously published without village boundaries, were completed with village boundaries, corrected, and brought up to date for republication. Of the large scale maps, press order was given on 50 sheets on the scale of 50 feet=1 inch, and 8 sheets on the scale of 400 feet=1 inch of the Moulmein town maps ; 51 sheets of the Rangoon Town Survey were also sent to press for reproduction. Of the office copies, 5 standard sheets of Bengal, 5 of Bombay, 22 of the North-Western Provices and Oudh, and 19 of Punjab were revised and corrected as to their boundaries and brought up to date ; also 15 *pargana* maps of Bengal and 7 of the Central Provinces. Seven (old) standard sheets of the Punjab, 1 of the North-Western Provinces and Oudh, 39 *pargana* or main circuit maps of Bengal on the scale of 1 inch=1 mile were touched up, corrected and brought up to date for republication. Of the district maps on the ½-inch and ¼-inch scales, 2 districts of the Punjab, one North-Western Provinces and Oudh, 3 in Bengal, and 2 in the Central Provinces were corrected and brought up to date from information supplied by the local authorities.

43. In the Cadastral Section 4,731 cadastral sheets were published of which 3,306 belonged to the North-Western Provinces, 1,114 to Burma, and 311 to Assam.

44. The Bengal Provincial Drawing Office continued to be employed on the compilation of standard sheets on the scale of 2 inches=1 mile for reduction to half from the 16 inches=1 mile cadastral maps of Bihar, Orissa and Chittagong. The number of cadastral maps dealt with during the year was as follows : Bihar, 1,672 ; Orissa 4,864 ; Chittagong 1,847. The outlining of 11 standard sheets in 44 sections of Bihar was completed, of which 16 sections were sent to the Photographic office for reduction to the 1-inch scale. The greater portion of the Chittagong cadastral maps have been reduced by pentagraph to the scale of 2 inches=1 mile ; the drawing of the standard sheets will shortly be taken up.

45. In the Engraving Office the quarter sheets of the Atlas of India have been steadily worked upon, six new plates having been completed ; 65 new quarters have been added to with the latest material, while 63 published quarters and 26 published full sheets have been brought up to date for printing, and 25 new ones have been projected and the borders cut on them. The hills have been put in hand on the new 128-mile map of India, and the 256-mile map brought up to date. Of the provincial maps on the 16-mile scale, Gujarât has been published with hills ; Bengal in two sheets, Bombay and Madras in six sheets, Râjputâna in two sheets, and Punjab and Kashmir in four sheets, have all had new material added to them. Two provincial maps for administration reports have been added to, 14 district maps for the same purpose completed and published, and 21 others were in hand in various stages of progress. Four sheets of the plan of Calcutta, a plan of Simla and Jutogh, the Index Chart to the Great Trigonometrical Survey, two India Weather Charts, and 51

miscellaneous plates have been in hand during the year. The Copper-plate Printing Section of this office pulled more impressions, and the Steel-facing Section dealt with more plates than last year.

46. In the Photographic and Lithographic Offices, the amount of work received for reproduction was somewhat less than usual, owing to a large reduction in the number of cadastral sheets sent in (about 1,100 less than last year), and to a slight decrease in the number both of departmental subjects and in those received from other departments. The aggregate outturn of the office is nevertheless well up to the average of former years. The number of original subjects dealt with was 6,364, or 1,516 less than last year, and they comprised 785 departmental maps, 4,477 cadastral maps, and 1,102 maps, plans, etc., received from other departments. The total value of the work done was R1,92,927, as against R2,13,518 last year.

The outturn of the zincographic and lithographic machines and presses was 695,812 copies, or 157,260 less than last year. The number of pulls, however, was nearly the same, *viz.* 845,562, as against 853,945. There was a large increase in the number of copies of departmental maps printed, the defect being in copies of cadastral maps and of subjects reproduced for other departments. The type-printing work has increased largely during the year, the number of copies printed amounting to 700,756 from 13,819 pages or items set up, as against 529,664 from 10,054 pages last year. The Heliogravure Section, as usual, shows an increase of printing work done, with an outturn of 73,801 prints from 101 photo-etched plates, or an increase of 1,555 prints over last year. In this section 82 half-tone blocks were prepared by the newly introduced enamelline process, from which 8,100 prints were struck off in one of the type-machine presses—a very substantial increase to the ordinary work of the Section. Somewhat less silver and cyanotype printing than usual was done during the year, the demand for this class of work varying considerably from year to year. Full details of the work done in each section will be found, as usual, in the Appendix.

It is satisfactory to record that orders were received during the year to publish the third edition of the map of India on the 32-mile scale, which has been for some years in abeyance pending the final settlement of frontier boundaries. Much work had to be done to the map before it could be issued, but there is every prospect of its final publication shortly. A skeleton map of the Punjab and surrounding country, on the 32-mile scale, and two maps of Bengal, Bihar, Orissa and Chota Nágpur, one on the 32-mile scale, and the other on the 16-mile scale, were published during the year. A large number of district maps were either published or reprinted, and also 221 standard sheets of the Topographical and Revenue Surveys on various scales. City and Cantonment maps of Simla and Jutogh, Jubbulpore, Sipri, Allahabad and Bareilly were also printed, and a large variety of other miscellaneous departmental work was done as usual.

The principal item of extra departmental work done was the illustration, with 29 maps and diagrams, of the plague report issued during the year by the Home Department. These were all either lithographed or photozincographed in colours, and 29,000 copies in all were supplied. A map of Siam and various district maps of that country were photozincographed, and copies supplied to the Director of the Royal Survey Department, Siam; and for the Colonial Secretary, Singapore, a map of Penang Island and the province of Wellesley was photozincographed. A number of maps were reproduced for the military authorities, including maps of the country round Ajmere, Deoli, Nusseerabad, Neemuch, Sirdarpore, Mhow, Kohát, Abbottabad, Umballa and Meerut. The reproduction of the map of Rangoon town in 358 sheets on the scale of 50 feet to an inch was commenced during the year, and blue prints of 77 sheets were supplied to the Rangoon Municipality. Eight sheets of the Moulmein Town Survey, on the scale of 400 feet to 1 inch were photozincographed for the Director of Land Records and Agriculture, Burma, and also a cantonment map of Moulmein. Work of the usual miscellaneous character was executed for the Public works, Telegraph and Meteorological Departments, for the Archæological Survey and the Asiatic Society of Bengal, further particulars of which are given in Part III of this Report.

In the Heliogravure Section 13 plates were photo-etched for the Technical Art Series of the year, 12 plates each for the Indian Museum notes and the

report on the Zoology of R.I.M.S. *Investigator*, 14 for a catalogue of *Echinoderma* for the Indian Museum, 17 for the report on the earthquake of 1897 by Mr. R. D. Oldham, and 6 for the eclipse report issued by this department. The enamelline half-tone blocks prepared included 37 enlarged copies of thumb impressions for a report on the subject prepared by Mr. E. R. Henry, C.S., and 18 views from negatives illustrating Mr. Oldham's earthquake report. In addition to the regular work of the Section, some useful experimental work was done in trichromatic photography and in electro-deposition for the correction of hand-engraved copper plates.

Considerable assistance was afforded by the Photographic Branch of the Office to the Astronomer Royal, Sir Norman Lockyer and other scientists, who came out from England for the purpose of observing the total solar eclipse of the 22nd January 1898. A small party under Mr. Pope also proceeded to Dumráon to obtain photographs of the corona with the old photo-heliograph belonging to the office, and the results obtained were completely successful. A report on this expedition has already been submitted to the Government.

47. In the Map Record and Issue Office the number of new maps and editions of departmental subjects received during the year amounted to 2,787, of which 2,489 were cadastral maps. The total number of maps issued was 156,523, and their value R117,942, which shows a decrease of 50,807 in number and R39,985 in value on those of the preceding year. The cash sale of maps amounted to R19,314, which also shows a decrease of R5,345 below the cash receipts of the past year.

48. In the Mathematical Instrument Office the total number of instruments issued was 59,100, and their value R2,83,857, against 50,727 and R2,68,704, issued during the preceding year. The number of instruments received into store was 54,246, and their value R2,61,816, against 61,558, and R2,59,405, last year. There has been an increase in the number and value of instruments issued during the year; there has also been an increase in the value of instruments received though their number is less. The number of instruments taken from the repairable stock and rendered serviceable was 7,644, and their value R92,059, against 20,857 and R82,453 last year. This shows an increase in value though a decrease in number.

The conversion of old pattern levels and theodolites has been steadily continued and 80 levels of obsolete pattern have been converted into serviceable instruments and issued. Since the increased establishment for the repair of instruments was sanctioned 416 levels and 107 theodolites have been converted and issued and all indents for such instruments have been discontinued. The value of instruments indented for during 1898-99, from England amounted to £4,823. This shows a small increase over last year's figure, but is considerably less than the figures of former years.

49. The Trigonometrical Branch Office, Dehra Dún, was engaged mainly on the routine work appertaining to that office. Very considerable assistance was rendered to the two official British Solar Eclipse Expeditions, by sending a provincial officer and a number of computers to aid in recording and helping generally in the work of the Eclipse parties.

The usual meteorological and solar photographic observations were continued and the large photo-heliograph giving pictures of the sun 12 inches in diameter was again brought into use. The monthly magnetic observations which were commenced last year have been continued. The Computing Office and Drawing Section have also been kept fully occupied.

The training school has more than justified its institution. Seventeen pupils were entertained and put through a complete course of plane tabling and traversing, and a certain number of them were instructed in levelling. All passed the examination at the end of the course and the greater number of them promise to become valuable surveyors.

For the first time, the newly-appointed Provincial officers were sent to Dehra to go through a course of training. The results have been excellent and the advantage to the department can hardly be over-estimated of having the newly-joined assistants thoroughly grounded in the theory and practice of both field surveying and the use of instruments.

Six of the Provincial officers went through the course extending over 10 months, and were all pronounced thoroughly fit for field work at its completion.

50. The Forest Survey Branch Office at Dehra Dún was engaged as usual upon the final computations of the several field detachments; on the up-keep of the Forest Department map records; on the compilation and drawing of special maps; and on the training of surveyors for field work. Eighty-four special maps on various scales were prepared of which 29 have been published, 31 were in press, and 24 were in different stages of progress; of 4-inch standard sheets 92 were published, 131 were in press, and 168 sheets were in hand. One standard sheet on the 1-inch scale was also published. In addition to the above a considerable amount of colouring, tracing, mounting, and other miscellaneous work for forest and district officers was performed.

ESTABLISHMENT.

51. During the year under report the Department has lost the services of six officers of the Imperial Service.

Colonel J. E. Sandeman, I.S.C., Deputy Surveyor-General in charge Revenue Branch, attained the age of 55 years on the 3rd September 1898, and his services were replaced at the disposal of the Military Department from that date. He joined the Revenue Branch of the Department on the 6th October 1864. He was principally employed on revenue operations in the Punjab, North-Western Provinces, Assam, Bengal and Burma. He was in charge of the North-Western Provinces Cadastral Survey from November 1883 to the end of 1891, where he carried out for the first time cadastral operations combined with the writing of records by the aid of *patwáris* and local labour, which resulted in the completion of the cheapest accurate cadastral maps ever produced in any province. He was placed in charge of the Cuttack Cadastral Survey operations in the end of 1891, and was appointed Director, Bengal Surveys, in April 1892. He was appointed Deputy Surveyor-General, Revenue Branch, and also Director of Bengal Surveys on 26th March 1895; but the latter appointment was abolished in October 1895. It may safely be said that no officer in India had a greater practical knowledge of cadastral work combined with the writing of records than Colonel Sandeman, and his loss to the Department in that Branch is very great. A scheme devised by him for the future employment of the revenue surveyors of the Department to the greatest possible advantage to the Imperial as well as to the Provincial Governments is now under discussion, and it is believed will be introduced. Colonel Sandeman was an enthusiast in his work, and his constant application to it resulted in his having to take furlough before his time was completed, which was much to be regretted.

Colonel Sir T. H. Holdich, K.C. I.E., C.B., R.E., Superintendent, 1st grade, retired from the Survey Department from the 17th February 1898. He commenced his survey career as an assistant with the Bhután Field Force during the cold season of 1865-66, but was not appointed permanently to the Department until 23rd July 1866. After serving a little more than a year in Rájputána he was selected as one of the officers to accompany the Abyssinian Expedition in December 1867 returning to India in May 1869, when he joined the Topographical Survey Party in Central India. In 1877 he was given charge of the Vizagapatam Survey, after which he took furlough to England, before the expiration of which, however, he was recalled to join the Southern Afghánistán Field Force in December 1878; he was afterwards attached to the Northern Afghánistán Field Force; for his services during these two compaigns he received a Brevet Majority. After the Afghán war he was placed in charge of the Kohát Topographical Survey, and thenceforth he was always employed on surveys either on or near the North-Western Frontier. In 1881 he accompanied the Wazíri Expedition, and in 1889-90 the Zhob Gomal Expedition. From August 1884 to November 1886 he was Chief Survey Officer with the Afghán Boundary Commission, and he then received a Brevet Lieutenant-Colonelcy. He accompanied Mr. Udny in November 1894 with the Kunar Valley Delimitation Expedition, in 1895 he accompanied the Pamir Commission, and in 1896 was appointed British Commissioner for the delimitation of the Perso-Balúch Boundary. He was made Chief Survey Officer in charge of all the detachments accompanying the different expeditionary columns on the North-Western Frontier in 1897-98, which appointment he held till his retirement from the Survey Department. It is greatly due to Sir Thomas Holdich's untiring zeal that the Survey Department

now possesses reliable maps of the whole of Balúchistán and of the countries bordering in the North-Western Frontier and elsewhere. In May 1894 he was made a C.B. and a C.I.E., and in June 1897 he was appointed K.C.I.E. He also received the gold medal of the Royal Geographical Society for 1887 for his Afghán Boundary Surveys.

Mr. E. C. Barrett, Superintendent, 1st grade, retired from the service on superannuation on the 15th April 1898. He joined the Provincial Service (Junior Division) on the 18th November 1862 and was promoted to the Imperial Service (Senior Division) on 30th December 1868. During his whole period of service of nearly 36 years he was employed on Revenue Surveys in Sind, Central Provinces, North-Western Provinces and Oudh, Cuttack, Burma and Assam. He served with the Lushai Expeditionary force in 1871-72, for which he received a medal and a clasp and the thanks of the Government of India.

Major-General R. G. Woodthorpe, C.B., R.E., Officiating Deputy Surveyor-General, died on the 26th May 1898. He joined the Topographical Branch of the Department in July 1871. He accompanied the Lushai Expeditionary force in 1871-72, the Gáro Hills Expedition in 1872-73, and the Nága Hills Punitive Expedition in 1875, when he was mentioned in despatches. In October 1878 he joined the Kurram Column of the Afghán War and was present at the action in the Peiwar Kotal, where he was slightly wounded; he was again mentioned in despatches. He accompanied the forces during the second Afghán War, and was present at the actions at Alikhel, Killa Kariz Mir, and Charda, the attack of Takhti-Shah Asmai and subsequent operations till 23rd December 1879, he was also present at the skirmish at Saidabad, when he was again slightly wounded; for his gallant services he received the thanks of the Governor General in Council and the Secretary of State for India; he was mentioned in the despatches of Generals Roberts and Ross, and was promoted first to Brevet Major in November 1879, and then to Brevet Lieutenant-Colonel in March 1881. On the conclusion of the Afghán War he returned to Assam, and in 1883-84 he accompanied the Aka Expedition. In the following year he, with Major C. R. Macgregor, visited the Bor Hkamti country on the western branch of the Irrawaddy. Immediately after his return to Shillong, after this trying experience from which he suffered much in health, he was ordered to the North-West Frontier on special duty at Gilghit. After a year at that place with General Lockhart's mission, he was sent in charge of a survey party which accompanied a military column from Assam, *viâ* Manipur, into the Chindwin Valley in Upper Burma, when a large area of previously unknown country was reconnoitred. The excellent service rendered by him in various parts of the frontiers, under such hazardous conditions, were recognized by Government by conferring on him the title of Companion of the Bath.

In February 1889 he was appointed Deputy Quarter Master General for Intelligence, but in June 1892 he returned to the Survey Department and was placed in charge of a topographical party in Upper Burma. In 1892-93 he conducted the survey operations in connection with the eastern portion of the Anglo-Siamese Boundary, and in the cold weather of 1894-95 he accompanied the Mekong Commission. After this his health having given way he took furlough for two years, which he was obliged to extend on medical certificate for three months. In November 1897 he returned to India and was appointed to officiate as Deputy Surveyor-General, which appointment he was holding when he died. By his death the Department has lost the services of a most valuable officer, and all those who knew him have to deplore the loss of one of the most genial and sincere friends that man could wish for.

Mr. J. S. Pemberton, Officiating Deputy Superintendent, 1st grade, retired from the service on 1st October 1898. He joined the Revenue Branch of the Provincial Service (Junior Division) on the 6th October 1860, and during his entire service of 38 years he was employed on revenue survey operations in the Central Provinces, Assam, Punjab, Bihar and North-Western Provinces, except for two short periods when he was attached to the Head-Quarters Office, Calcutta. He was promoted to the Imperial Service on the 1st April 1892, and held charge of traverse survey parties in the North-Western Provinces from October 1895.

Captain A. J. Pilcher, R. E., Officiating Deputy Superintendent, 2nd grade, reverted to the Imperial establishment on the 10th December 1898. He joined

the Survey Department on the 16th July 1892. During his short service in the Department he was attached to the Bihar Cadastral Survey, for a season, and to the Burma Trigonometrical Party for two seasons. In September 1895 he was placed in charge of the Bombay Topographical Survey and he was transferred with that party the following season to Burma, remaining with it till 15th April 1897, when he was again placed in charge of Nos. 10 and 21 parties.

52. In the Provincial Service there were three vacancies, *viz.*, two by the retirement of Messrs. W. A. Wilson and H. W. Peychers, and one by the resignation of Babu Sarat Chunder Sen. Four officers, *viz.*, Messrs. J. Smith, C. G. Lee, F. P. Walsh, and H. W. Biggie have been lent to the Government of Siam. On the 1st October, owing to Mr. Pemberton's retirement, an appointment in the 2nd grade of Deputy Superintendent was transferred to the Provincial list, thus creating the first appointment of 2nd grade Extra Deputy Superintendent.

PART II.

THE OPERATIONS OF THE SEVERAL FIELD PARTIES.

TRIGONOMETRICAL SURVEYS.

PRINCIPAL AND SECONDARY TRIANGULATION.

BALÚCHISTÁN.

No. 24 PARTY.

Personnel.

Captain J. M. Burn, R.E., Officiating Deputy Superintendent, 1st grade, in charge till 12th April 1898.
Lieutenant H. H. Turner, R.E., Assistant Superintendent, 1st grade, in charge from 8th August to 30th September 1898.
Mr. J. Hickie, Extra Assistant Superintendent, 4th grade, in charge from 13th April to 7th August 1898.
Mr. P. F. Prunty, Extra Assistant Superintendent, 6th grade.

53. This party, under Captain Burn, R.E., started from Karáchi for Makrán on the 9th September 1897. A special British India steamer had to be hired to take the party to Ormára, as there is no regular service between Karáchi and Ormára. A halt of some three weeks was made in Ormára, during which time instruments and lamps were tested. There was some difficulty in collecting sufficient transport, and sufficient camels were only obtained by indenting on the Las Bela State.

54. The work of this party was commenced at the end of October 1897, the idea being to continue the triangulation of the Makrán Longitudinal series westwards. Unfortunately the season started badly as when Captain Burn had observed the angles and an azimuth at Kargazi H. S. he had a bad attack of fever which laid him up for nearly three weeks. After observing at Hazárbuzi H. S. he was again taken ill. Lieutenant Turner observed the angles at Kapar H. S. in the same quadrilateral as Hazárbuzi and Kargazi, and then went to Girdank H. S., the south-western station of the second quadrilateral. These were the only four stations at which final observations were taken, no single figure being completed. The approximate work laid out in advance this year comprised three figures, a quadrilateral, a tetragon and a double quadrilateral included by ten stations, covering an area of 1,400 square miles, and extending over a direct distance of 70 miles. Of the ten stations, two were old ones and seven were newly selected and built, and one point was not built on.

55. One secondary station, Chambor, in the Kolwa valley, was also selected and built, but final observations were not taken at it. The season came to an abrupt conclusion owing to the rising in Makrán. Captain Burn's main camp itself being attacked and several men killed. All the property, both Government and private, being looted, besides R15,000. Captain Burn himself, who was not in the camp at the time, fortunately escaped and managed to reach Ormára; the other members of the party, who were scattered over the country, also managed to reach the coast in safety. One lamp squad, consisting of four men, who took refuge in Nag fort, were afterwards killed by the insurgents. The other lamp squads all escaped, some to Karáchi, some to the coast.

56. The principal observations were taken with Troughton and Simm's 12-inch micrometer theodolites Nos. 1 and 2. The method of observing was to measure angles on nine zeros, two faces on each zero and two swings on each face. Unfortunately both instruments were seriously damaged, No. 1 beyond repair, No. 2, however, has been sent back to the makers and is being repaired.

57. The health of the party was not very satisfactory, the *khalásis* were continually suffering from sores. Recorder Dhondu Balwant Joshi died at the commencement of the season and besides him, irrespective of the men killed, four others died from natural causes. The cause of all this sickness probably is not so much due to hardships undergone as to the bad state of health in which the men started owing to the famine of 1897.

58. The party was inspected by the Superintendent, Trigonometrical Surveys, on 21st September 1898.*

* The Officer in charge is perfectly satisfied with the work of all his assistants.

TOPOGRAPHICAL SURVEYS.

UPPER BURMA.

No. 10 Party.

59. Captain A. J. Pilcher, R.E., continued to hold charge of this party up to 9th November 1897, when he proceeded on privilege leave, previous to reverting to military duty on the Home establishment; the direction then devolved on Lieutenant W. M. Coldstream, R. E., who held charge of the party for the rest of the year, except for the period from 1st June to 27th July 1898, when he was on privilege leave, and Lieutenant H. J. Hare, R.E., held charge.

Personnel.

Captain A. J. Pilcher, R.E., Officiating Deputy Superintendent, 2nd grade, in charge up to 9th November 1897.
Lieutenant W. M. Coldstream, R.E., Officiating Deputy Superintendent, 2nd grade, in charge from 10th November to 31st May, and again from 28th July 1898.
Lieutenant H. J. Hare, R.E., Officiating Deputy Superintendent, 2nd grade, in charge from 1st June to 27th July 1898.
Mr. G. D. Cusson, Extra Assistant Superintendent, 4th grade
" G. T. Hall, " " 5th "
" P. J. Serrao, Sub-Assistant " 1st "
" J. A. Freeman, " " 2nd "
10 Sub-Surveyors, 5 Probationary Sub-Surveyors, 1 Writer and 1 Hospital Assistant.

60. During the previous season No. 10 Party had worked in conjunction with No. 21 Party in the Northern Shan States, but during the recess season 1897 a special sphere of operations had been laid down for the party in Upper Burma, and the triangulators were accordingly employed in the newly allotted area, while the majority of the surveyors completed the detail survey of sheets Nos. 401 and 402 and half of sheet No. 458 in the Shan States, which had been triangulated in season 1896-97.

61. The party left recess quarters at Bangalore on the 9th November, arriving in Mandalay on the 18th, and leaving again for its ground on the 22nd idem.

62. Mr. G. D. Cusson with 11 sub-surveyors took up the work in the Shan States in the vicinity of Kehsi Mānsām (sheets Nos. 401, 402, 458). Two assistants and one sub-surveyor triangulated in sheets Nos. 261, 262, 263, 264, 265, 266, Upper Burma, and one assistant was employed in executing a series of triangulation from the Mandalay meridional G. T. series in the neighbourhood of Katha to the Chinese Frontier, in order to provide the survey detachments with the Chinese Boundary commission with initial data.

On Mr. Serrao's return from the completion of this series he was directed to take up triangulation in sheet No. 256, and the two sub-surveyors with him were employed on the detail survey of sheet No. 259.

63. The outturn for the season is as follows:—

Triangulation Frontier Extension Series . .	From Katha to Chinese Frontier.
	Square miles.
Triangulation for detail survey	2,742
Topography on 1-inch scale (including 205 miles overlap)	2,116

This shows a considerable improvement in quantity as compared with the previous season, and a similar improvement was shown in the quality of the work.

64. The country surveyed in the Shan States occupied a comparatively open, healthy table-land lying at an average elevation of 3,000 feet above sea-level. The triangulators were, however, working in very jungly, unhealthy country, forming the scarp between the Shan plateau and the plains of Burma.

65. The health of the party was on the whole good, that of the detachment in the Shan States being excellent. The triangulators and their *khalásis* suffered to some extent from fever. At the close of the field season the officer in charge of the party was laid up with dysentery, and he and one assistant have eventually been invalided to England.

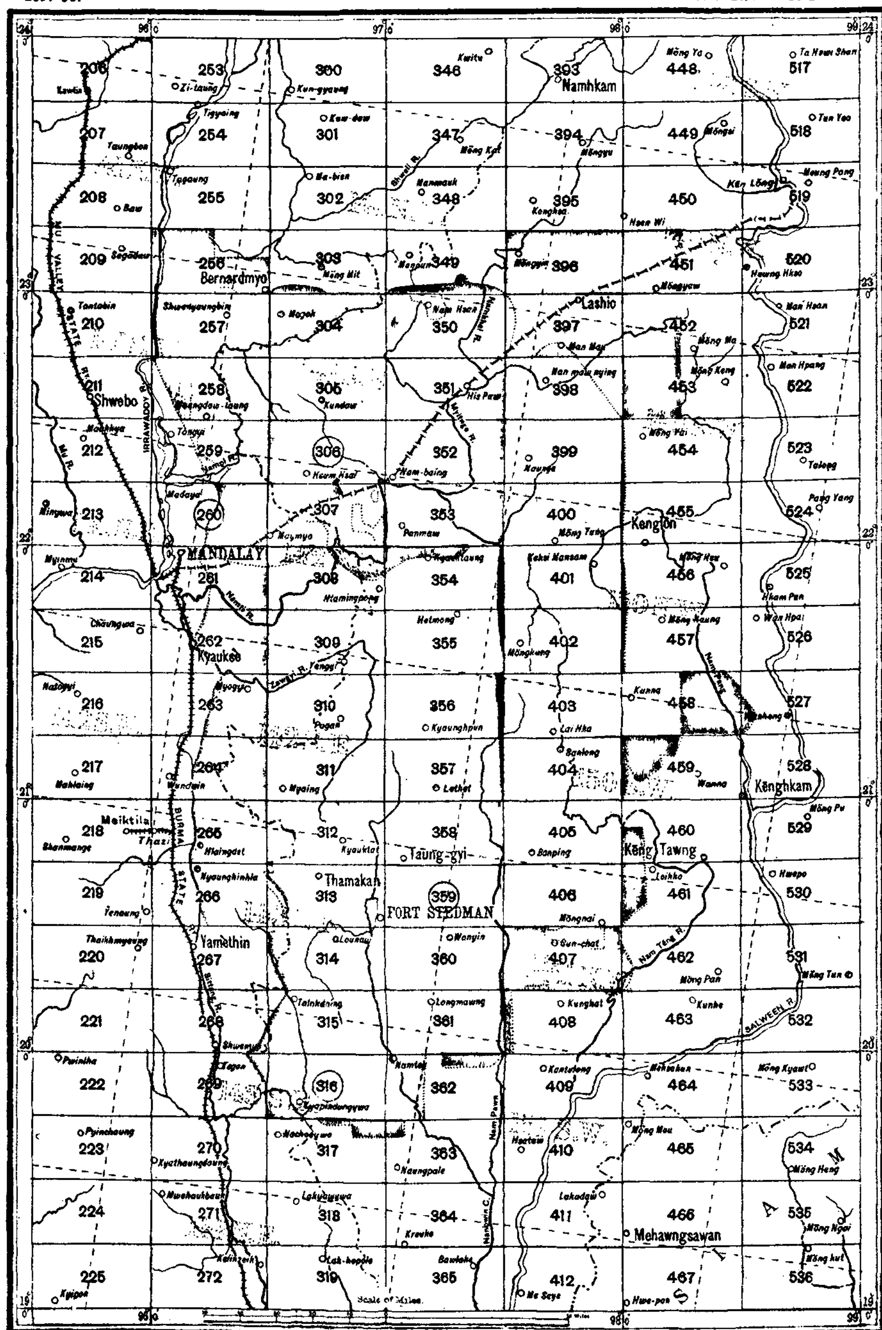
66. The party reassembled at Mandalay by the 19th May and reached Bangalore on the 26th, the recess office being opened on June 1st.

67. During the recess the computations have been brought up to date, and sheets Nos. 401 and 402, and the western half of sheet No. 458, have been

UPPER BURMA SURVEY.

INDEX TO THE TOPOGRAPHICAL SURVEY IN UPPER BURMA & SHAN STATES.

1897-98. Nos 10,11 & 21 PARTIES.



Ref. No. 328, S. I. D.—Feb. 99.—550. Photo. S. I. O., Calcutta.

REFERENCES.

Sheets published are shown thus .... (316)

Area previously Surveyed ....

.. ,, .. Surveyed in Season 1897-98 ....

.. ,, .. Triangulated in advance ....

.. ,, .. ,, .. ,, .. during the Season 1897-98

NOTES.

The numerals 312, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

The figures and lines in strokes represent the numbers and limits of the Engraved sheets of the Indian Atlas.

No. 420-S. 99.

prepared for publication in two colours. Sheet No. 259 has also been partially drawn.

68. The total cost of the party for the year was R85,179, and the cost rates per square mile are—

	R	a.	p.
For triangulation	13	3	7
For topography	21	13	10

69. The programme for next season is—

The triangulation of sheet No. 255 and the completion of sheet No. 256.

The triangulation of the unsurveyed gaps in sheets Nos. 210, 211, 212, 267, 268, and a network to connect the gaps in the neighbourhood of sheets Nos. 170, 171, 219 and 220. In detail survey, the completion of the large scale survey begun by No. 3 Party of the country round Maymyo, and the 1-inch survey of the eastern halves of sheets Nos. 261, 262, 263, 264, 265, 266, 267 and 268.*

UPPER BURMA.

No. 11 Party.

70. Captain Renny-Tailyour's services being required for the China-Burma Boundary Commission, Mr. P. J. W. Doran was put in charge of the party from the 4th November.

Personnel.

Captain T. F. B. Renny-Tailyour, R.E., Officiating Superintendent, 2nd grade, in charge till the 3rd November.

Lieutenant W. M. Coldstream, R.E., Officiating Deputy Superintendent, 2nd grade, transferred to No. 10 Party from the 1st November.

Mr. P. J. W. Doran, Extra Assistant Superintendent, 4th grade, in charge from the 4th November.

" W. M. Kelly, Extra Assistant Superintendent, 5th grade.

" P. White, Extra Assistant Superintendent, 6th grade.

" H. G. Shaw, Sub-Assistant Superintendent, 1st grade.

" H. H. B. Hanby, Sub-Assistant Superintendent, 2nd grade, up to 19th February.

Surveyors and Sub-Surveyors.

Mahmud Husain, J Sebastian, Ramsabad Abdul Rahim, 14 Sub-Surveyors and Probationary Sub-Surveyors.

71. The party lost the services of two of its best native surveyors Mahmud Husain and Abdul Rahim, owing to their accompanying Captain Renny-Tailyour. Mr. Shaw was temporarily detached to carry on a secondary series from a base of the Mönghsat G. T. series to the China Boundary on the Mekong river, accompanied by Surveyor Ramsabad. Mr. Hanby's services were lost owing to his unfortunately contracting dysentery on his way to Fort Stedman. Acting under medical advice he left for the hills and was later on appointed to the head-quarters office, Calcutta. Two probationary sub-surveyors were appointed from Dehra Dún Training School. They joined the party at Rangoon on the 5th and 9th November, respectively.

72. The party left recess quarters on the 3rd November, with the exception of Mr. H. G. Shaw and Mr. H. H. B. Hanby, who had started a week in advance, sailed from Madras on the 4th, and arrived at Rangoon on the 8th. Here the party was joined by men returning from departmental leave and left Rangoon for Thazi by rail, and thence by daily marches for Fort Stedman, which was reached on the 23rd November and which was to be the head-quarters of the party during the field season. Arrangements were made for taking the field and a start made on the 4th December.

73. The programme of the season was:—

(a) Detail survey of sheets, Nos. 403 to 406, and the resurvey of a portion of sheet No. 407, on the 1-inch scale.

(b) The triangulation "in advance" of sheets, Nos. 310, 311, 356 and 357.

The former was completed, but the latter could not be finished off owing to the loss of Mr. Hanby's services. Sheets Nos. 310, 311 and 357 have been triangulated and sheet No. 356 has been partly reconnoitred.

Triangulation was carried on in the districts of Möng Nai, Möng Pīng, Lai Hka, Lawk Sawk, Ye Ngan, and Baw-ye-u. Secondary triangulation was carried on from the Mönghsat G. T. series to the China Boundary.

* The officer in charge reports that Mr. G. T. Hall deserves special mention for the excellence of his work, and among the sub-surveyors, Shaikh Mahomed and Shaikh Abdullah did specially good work.

74. Topographical work was carried on in the Sawbwa portions of Möng Nai, Lai Hka, Mawkmai, Möng Pawn and Myoza portions of Möngsit and Möng Küng. The ground was hilly and intricate, mostly covered with tree and scrub jungle, and numerous "devil's cauldrons" were met with. The flat and undulating portions were mostly overgrown with *kain* grass and dotted over with hillocks, the latter, as a rule, being covered with sharp pointed rocks and inaccessible.

75. The Officer in charge personally undertook the secondary triangulation of sheet No. 357 in the absence of Mr. Hanby, and instructed the new hands in their duties, as well as exercising a general superintendence of the whole work in hand.

76. The outturn of work is as follows:—

	Square miles.
Triangulation	1,833
Do. secondary series to China boundary	1,040
Topography, 1-inch scale (including 241 square miles of overlap)	2,571.

77. The health of the party was not as good as in previous years. One European assistant fell sick at the commencement of the field season and had to leave for the hills. Several of the surveyors suffered during the season; some have only just recovered from the fever contracted there. Many of the menial establishment contracted fever and dysentery on their way up. Six men, *i.e.*, four natives of India and two Burmese interpreters died during the season.

78. The programme for the ensuing season will be the detail survey of sheets Nos. 310, 311 and 357 and endeavours will be made to complete sheet No. 356, whilst sheets Nos. 308, 309, 354, 355, 356, 456 and 457 will be triangulated in advance for the detail survey of season 1899-1900.

79. The Surveyor-General visited the party at the end of September and after a minute examination expressed his satisfaction with all he saw.*

UPPER BURMA.

No. 21 Party.

80. Lieutenant Hare took over charge of this party on the 1st October 1897 from Captain Pilcher, R.E., who was under orders to revert to home service in the following month.

Personnel.

Lieutenant H. J. Hare R.E., Assistant Superintendent, 1st grade, in charge.
Mr. A. J. James, Extra Assistant Superintendent, 3rd grade.
" W. F. E. Adams, Sub-Assistant Superintendent, 1st grade.
" P. Williams, Sub-Assistant Superintendent, 3rd grade.
" P. R. Anderson, Sub-Assistant Superintendent, 3rd grade.

Surveyors and Sub-Surveyors.

Ganu Mal, Natha Singh, Mohamed Latif, Jamna Pershad, Keshao Jadoo and 7 probationary and apprentice Sub-Surveyors, 1 Writer, 1 Hospital Assistant and 1 Shan Interpreter.

81. One Sub-Surveyor was sent to accompany the Civil Officers delimitating the boundary between the Chin Hills district and Upper Burma.

82. The party left recess quarters at Bangalore during the first week of November and proceeded to Lashio in the Northern Shan States, where the head-quarters of the party were established. Field work ceased about May 1st and the party left Rangoon by the steamer of the 21st May, the recess office at Bangalore being opened on June 1st.

83. The operations of the season included the survey on the 1-inch scale of sheets Nos. 398, 399 and 400, the last two being required to assist the railway engineer in selecting a line into the Southern Shan States.

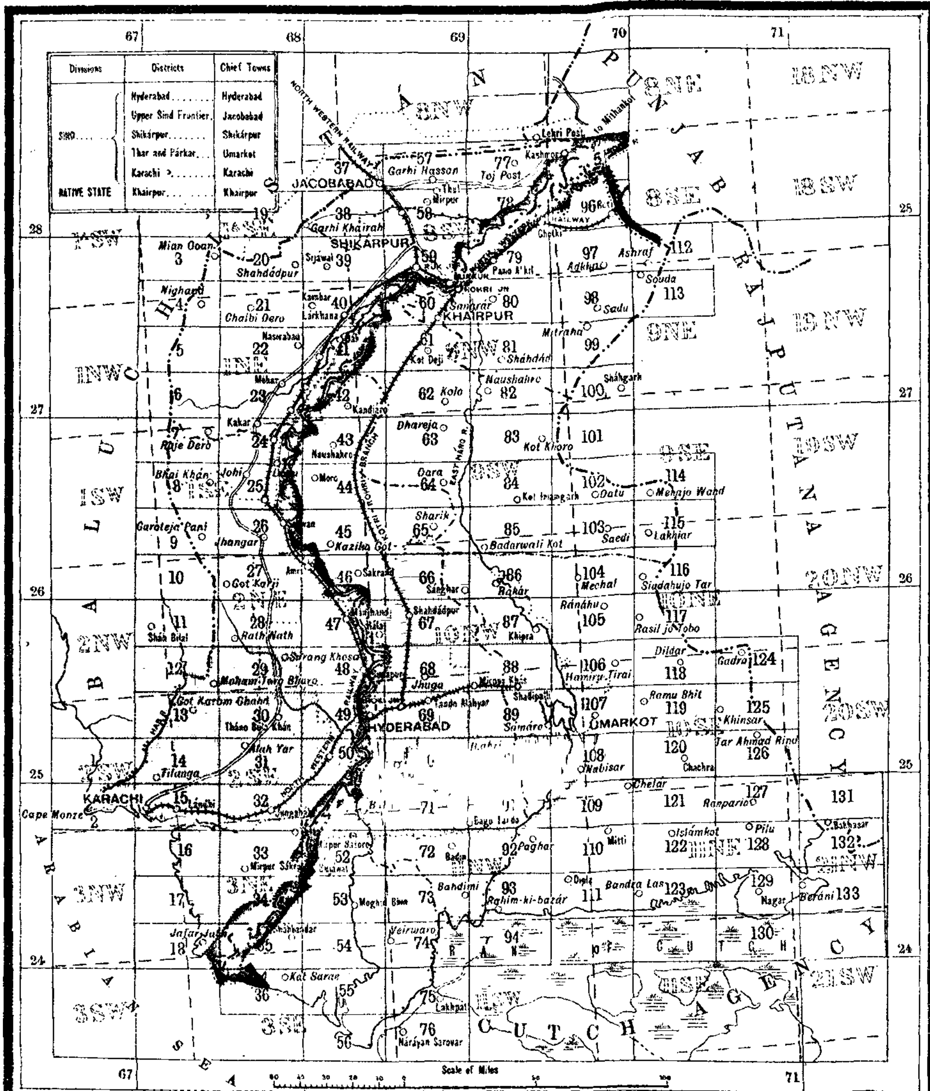
Triangulation in advance was carried on in sheets Nos. 396, 397 and parts of 451, 452 and 453.

84. The outturn of work is as follows:—

	Square miles.
Triangulation for the 1-inch scale	3,256
Topography 1-inch scale	2,595
Do. ¼-inch "	1,752

* The officer in charge reports favourably of the services of Messrs. W. M. Kelly and H. G. Shaw. Mr. Kelly had charge of plane tablers during the field season and of the drawing during recess.
He also reports favourably of surveyors and sub-surveyors Ramsabad, Kudratulla, Mowni Ram, Hayat Mahomed, and probationary sub-surveyor Hafizuddin and writer Chandoo Meean. Special mention is made of surveyor J. Sebastian's work.

1897-98. # SIND SURVEY. Nos. 12 and 15 PARTIES



Regr. No. D. 730. S. I. D. - Sep. 98 - 660

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún, September 1898.

No. 230-S. 98.

REFERENCES.

Surveyed in previous Seasons Scale 1" = 1 Mile by No. 12 Party ...

Do. ....do........2" = 1 Mile .....do... ...

Do. 1897-98..............2" = 1 Mile... ... do. .....

Triangulated and Traversed in advance...... ... ... do.. ...

Surveyed in previous Seasons Scale 1" = 1 Mile by No. 15 Party...

Do. 1897-98...............1" = 1 Mile ....do. ....

Triangulated in advance........... ... ... do.........

Indus Riverain Survey ....

NOTES.

The numerals 63, etc., indicate the Standard sheets on the Scale 1 Inch = 1 Mile.

The figures and lines in strokes represent the numbers and limits of the Engraved sheets of the Indian Atlas.

The area surveyed is very creditable considering that two of the best surveyors and one assistant were employed on the boundary work, and that two of the assistants were triangulating for the first time.

85. The country surveyed, which included parts of the Hsi Paw and South Hsinwi states is hilly, and, as a rule, covered with tree and scrub jungle. Hollows into which the surrounding drainage disappears or devil's cauldrons, a feature of the Shan States, were very numerous in parts.

Several herds of wild elephants were to be found near Lashio, and in one case were a source of some danger to the party working in that district.

Loi Ling, 8,771 feet, the highest hill in this part is noticeable for the dense growth of wild tea with which a large part of it is covered, and also for the remarkable size of some of the tea trees.

86. The total cost of the party is R81,761, and the cost rates per square mile are as follows:—

Triangulation for 1-inch survey,	R11-5-1	per square mile.
Detail survey on 1-inch scale,	R18-4-11	„ „
Do. do. ¼ do.	R 4-4-9	„ „

These figures compare favourably with those of former years.

87. The surveyors were systematically visited and their work carefully tested with excellent results.

88. During the recess the whole of the computations were brought up to date and the mapping of sheets Nos. 304, 307, 398, 399 and 400 and most of 350 was completed.

89. The programme for the next season is as follows:—

Lieutenant Hare with a detachment will accompany the Burma-China Boundary Commission.

Two surveyors will accompany Captain Pottinger on his reconnaissance to Yunnan from the Shanghai side and a similar detachment will probably be sent with Captain Ryder from the Kunlôn side.

Triangulation will be pushed on up to Kunlôn where a useful connection will be given to both the Boundary Commission and to Captain Ryder's party.

Sheet No. 397 and possibly No. 395 will be surveyed on the 1-inch scale and the triangulation of sheets Nos. 451, 452 and 453 will be proceeded with.

90. The recess office was inspected by the Surveyor-General at Bangalore in September, who expressed his appreciation of the efficient state in which he found the party.*

SIND.

No. 12 Party.

Personnel.

Mr. C. F. Erskine, Officiating Deputy Superintendent, 1st grade, in charge.		
„ R. C. D. Ewing, Extra Assistant Superintendent, 4th grade, up to 12th April 1898.		
„ G. G. Vander-Beck, „ „	5th	„
„ R. F. Warwick, „ „	6th	„
„ J. Smith, Sub-Assistant Superintendent, up to 25th July 1898.	1st	„
„ F. P. Walsh, „ „ up to 21st May 1898.	1st	„
Munshi Rahmatullah, „ „	2nd	„
Mr. E. C. J. Bond, „ „	3rd	„
„ C. J. Veale, „ „	3rd	„
58 Permanent and temporary Sub-Surveyors, Computers and Draftsmen.		

91. The operations during the year under report were in continuation of those of the previous season. Mr. C. F. Erskine held charge of the party throughout the season.

92. The programme, which was as follows, was completed:—

(*a*) The completion of the village boundary traverse survey in sheets Nos. 50, 51, 70, 71, 90, 91, 108 and 109 from the Indus river on the west to the desert on the east.

(*b*) The detail survey on the 2-inch scale of an area between the same limits in sheets Nos. 48, 49, 68, 69, 88, 89, 106 and 107.

* The officer in charge reports that Mr. James has again proved himself an able assistant, and that Mr. Adams and Mr. Anderson both did very satisfactory work.

Among the native staff Sub-Surveyor Natha Singh and Jamna Pershad are deserving of special mention.

93. The recess office at Mussooree closed on the 9th October 1897 and the party reassembled at Tando Adam on the 18th idem, and each man was on his ground by the end of the month.

94. The traversing consists of a village boundary survey with offsets and the area traversed is 2,971 square miles. There were 7¼ main circuits measured, 12 sub-circuits and 603 villages. The angular work was checked by observations for azimuth at 107 stations on main and sub-circuits, and the average angular error is 4 seconds. The linear measurements amounted to 3,115 miles, and were checked by 18 connections, with stations of the secondary triangulation executed during the previous season. The average correction per 1,000 links is 0·4 links. No permanent marks were laid down at traverse stations, but the position of all marks used to demarcate the village boundaries have been fixed by offsets, wherever possible.

95. The cost of the traverse survey amounts to R10·1 per square mile.

96. In addition to the village boundary survey, 123 bench marks of the Irrigation Department chiefly on embankments and canal banks, and 69 of the North-Western Railway were connected with the traversing involving additional observations at 742 stations, and 209·8 linear miles of chain measurements.

97. The area surveyed in detail on the 2-inch scale amounts to 2,709 square miles and was mapped on 52 plane-table sections. It comprises portions of sheets Nos. 48, 49, 106 and 107 and the whole of Nos. 68, 69, 88 and 89. An area of 84 square miles was also surveyed in standard sheet No. 70. In sheets Nos. 106 and 107 the survey has been carried to the edge of the desert. Sheets Nos. 48 and 49 have been surveyed up to the work of the Indus Riverain Survey. The remainder of these sheets will be surveyed on the 1-inch scale by No. 15 Party. The detail survey was carried out almost entirely by interpolation, and was based mainly on the traversing, it was tested from 1,588 *in situ* fixings, and a small amount of chain measurements, and was done under the direct supervision of the officer in charge and three assistants. The cost of detail survey is R14·6 per square mile, a rate almost identical with that incurred last year.

98. The character of the country surveyed varied considerably, in sheets Nos. 48 and 49 it was thickly populated and well watered, in sheets Nos. 68, 69, 88 and 89, the country to the west was generally, fairly well populated, and contained some large and flourishing villages, but journeying eastwards large tracts of waste land and sand are met with and the country is more sparsely populated; in sheets Nos. 89 and 107 a very large area was under water and a portion of the last mentioned sheet had to be left unsurveyed on this account. Near the Nára river there is a considerable amount of jungle, and further east the country is still thinly populated, although a few fairly flourishing villages were met with. The banks of nearly all the canals falling in the seasons work are lined with *bábul* trees.

99. There was little or no sickness.

100. In accordance with a request preferred by the Irrigation Department, a camp under the supervision of Mr. R. C. D. Ewing was detailed to undertake the survey of certain lands situated in Kalát, in connection with the proposed Desert Canal Scheme.

101. As there was a sufficient number of Great Trigonometrical Survey and triangulated stations of the Balúchistán Survey in the vicinity, and no defined village boundaries, traversing was carried on by means of lines running from one Great Trigonometrical station to another, these formed the sides of the main circuits, of which there were five and a subsidiary one; the main circuits were sub-divided into blocks by meridional lines of traverse five miles apart, the main circuit stations were primarily marked by embedding two bricks, on end, the stations on the block lines being similarly marked. The meridional lines were run so that the entire area might be divided into rectangular blocks of 5 miles × 2 miles, the corners being subsequently permanently marked by embedding pieces of rail, five feet in length, on the exact spots occupied by the bricks, these permanent marks will hereafter be utilized by the Irrigation Department as bench marks. The entire area surveyed was 1,554 square miles, consisting of five main circuits and one subsidiary; the angular work was checked by observations for azimuth at 40 stations, the average angular error being 5

INDEX TO THE TOPOGL. SURVEY OF THE LUSHAI HILLS.

1897-98. No. 14 PARTY.

BAY OF BENGAL

SYLHET. CACHAR OR SILCHAR. MANIPUR. AIJAL. LUNGLEH. COMILLA. NOAKHALI. CHITTAGONG. RANGAMATIA. AKYAB.

REFERENCE

Area Triangulated in advance 1897-98.

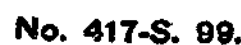
NOTES.

The numerals 403, &c., refer to the Standard sheets on the Scale of 1 Inch = 1 Mile, of the Provincial Indexes of Assam, Bengal, & Burma.

The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas.

Scale of Miles.

Photo. S. I. D., Calcutta.



seconds per station. The linear measurements amounted to 884 miles, and were checked by 17 connections with triangulated stations. The average correction per 1,000 links is 0·6 links.

102. The cost of traverse survey is R13,874, giving a cost rate of R8·9 per square mile.

103. The area surveyed in detail on the 2-inch scale, in Kalát, amounts to 1,477 square miles, and was mapped on 44 plane-table sections, and extends from Kashmor on the east to Shadihar on the west; it is a tract of country about 125 miles in length, with an average width of 12 miles, and is situated immediately north of the Upper Sind districts.

104. The cost of the 2-inch detail survey is R10·4 per square mile.

105. The character of the country topographically surveyed by the Desert Canal Camp may be divided into (*a*) well cultivated portion in the centre of the work, (*b*) waste *pat* land on the north and west, and (*c*) sandy wastes on the east. The portion under cultivation is well populated and very fertile; the *pat* land is peculiar, it is perfectly flat, bare of all vegetation and destitute of water; the soil is apparently good, and yields fair crops when cultivated by the help of canal water.

106. Field work closed very early in April and the party moved down to Karáchi for the recess. During recess the fair mapping of the entire area surveyed in detail was completed with the exception of a small portion of sheet No. 70, this sheet will be drawn next year when the survey is completed. The mapping was comprised in 75 quarter sheets, of which 22 were blank. They were drawn on the 2-inch for reduction by photography to one half, and have all been despatched to the Trigonometrical Survey office at Dehra Dún for publication. Sheets Nos. 48 and 49 have been drawn as far as surveyed. The remainder of these sheets will be mapped by No. 15 Party. Sheets Nos. 106 and 107 have been mapped as far as they are to be surveyed at present and will be published. The area surveyed in standard sheet No. 70 has not been mapped, the detail survey of the remainder of the sheet will be completed during the coming field season, and will be fair drawn in due course.

107. The triangulation and traverse charts of sheets Nos. 49, 50, 69, 70, 89, 90, 91, 107, 108 and 109 have been drawn. All the charts with list of co-ordinates have been despatched to Dehra. In addition to this 11 traverse charts pertaining to the work of the Desert Canal Camp have been prepared.

108. Next season triangulation and traversing in advance will be taken up in sheets Nos. 19, 20, 21, 37, 38, 39, 40, 57, 58 and 59. Detail survey will be carried on in sheets No. 50, 51, 70, 71, 90, 91, 108 and 109. The survey of about 30 square miles in the vicinity of Sukkur is to be undertaken, at the request of the Military Works Department.

109. Major Burrard, R.E., Officiating Superintendent, Trigonometrical Surveys, says, "I inspected the party and considered its work satisfactory. This is all the more creditable as Mr. Erskine has had considerable unforeseen difficulties to contend with."*

LUSHAI HILLS, ASSAM.

No. 14 Party.

110. Major Hodgson proceeded on furlough on the 19th June 1898, and Mr. Keating was placed in temporary charge of the party.

Personnel.

Major G. B. Hodgson, I.S.C., Superintendent, 2nd grade, in charge up to 18th June 1898.
Mr. J. Keating, Extra Assistant Superintendent, 6th grade, in charge from 19th June 1898.
Mr. R. Waller-Senior, Extra Assistant Superintendent, 6th grade.

Sub-Surveyors, etc.

Ram Singh, Mahadeo Daji, Abdul Haq, and four others.

111. The party left recess quarters on the 15th October 1897 and proceeded to the Lushai Hills. Field work was closed at the end of April, and the party returned *viâ* Silchar, Fenchuganj and

* Mr. Erskine reports that all his assistants worked well this season, while as regards the native establishment the sub-surveyors, with one or two exceptions, worked well throughout the field season.

Cherra Poonjee to recess quarters at Shillong, where the office was opened on the 25th May 1898.

112. The programme proposed in last year's annual report was carried out with modifications as suggested by the late General Woodthorpe when he proceeded to Silchar to inspect the arrangements made by the officer in charge for the commencement of the survey of the Lushai Hills, resulting in a larger outturn than would probably have been the case.

113. As there were no Great Trigonometrical Survey stations in the Lushai Hills, a series of first-class secondary triangles was commenced, starting from the Salama Tíla-Ramphan Great Trigonometrical Survey stations of the Eastern Frontier Series, near Silchar, eventually closing on a base of the same series near Rángámáti in the Chittagong Hill tracts. The total length of this secondary series will be about 170 miles, of which nearly 100 were covered by this season's triangulation. The sides of some of the triangles are of considerable length, between 30 and 40 miles. This work was carried out by Mr. Keating, and the results are very satisfactory.

All the stations of this series were selected beforehand with the aid of the maps and charts of the previous surveys of 1871 and 1889. The series closed for the season on two stations of the triangulation which was carried out during the military expedition of 1871-72, but the old marks were not found, having most probably been removed by the Lusháis. Major Hodgson, Mr. Waller-Senior, and two sub-surveyors were employed on net work triangulation in the immediate vicinity of Aijál, the head-quarters of the Lushai Hills, and completed 1,300 square miles. This work gave very satisfactory results when computed. This triangulation comprised the whole of sheets Nos. 161 and 162, and half of 163.

114. The outturn for the season was as follows:—

	Square miles.
Network triangulation	1,300
1st class secondary series, including an area of 700 square miles of country covered by the network triangulation	1,800

115. By the middle of March three sub-surveyors had completed the work they were told off to do, and the opportunity was taken to practise them in topographical work on the 1-inch scale, in which they had had no previous instruction. The work turned out, though carefully executed, cannot be relied on to form part of the season's outturn as it is based on two points only.

116. The field season was closed in April to avoid the great heat and heavy rainfall that prevails in the district during May, rendering the climate unhealthy to work in.

117. The country in which work was carried on this season was throughout densely wooded or covered with long hemp grass and bamboos, except where patches had been prepared for cultivation, and every hill-top selected as a station had to be cleared at a cost of several days' labour. The Lusháis cultivate on the *jhum* system. In the neighbourhood of Aijál, villages were numerous, but elsewhere the country was very sparsely populated, except in the direction of Lungleh to the south. Lungleh was formerly the head-quarters of the Political Officer of the South Lushai Hills which were included within the Lower Provinces of Bengal; a small detachment of military police was located there. This part of Lushai has lately been transferred to the administration of Assam; the North and South Lushai Hills have been amalgamated under one Superintendent. The hills, as may be seen from the old maps, consist of high parallel ranges running generally north and south, and divided by very deep valleys. The ranges rise to a height of about 5,000 feet, the valleys only 400 to 500 feet, above sea-level. The Lushai villages are generally perched on the tops of hills or on projecting spurs, and in the dry season the water supply is often a great distance away. They are abandoned every 4 or 5 years when a whole village community will move to a fresh site, build a new village, and clear new *jhums*, as the inhabitants do not consider that they get enough return from their labour by remaining longer in one place. Every village is known by the name of its chief for the time-being, though each site has a distinguishing name of its own. Where, however, villages are fairly numerous, almost every separate range and conspicuous hill has its name, so that the appearance on the map of

a name, which is really the name of the hill, does not necessarily indicate the presence of a village. It is therefore considered useless to show the village sites on the maps or enter the names of the chiefs, as the information would soon be obsolete.

118. Only one metalled road exists at present in the Lushai Hills; it commences at Silchar, proceeds *viâ* Kolosib outpost to Aijál, and thence on to Lungleh. This latter portion has just been completed.

119. Three hundred and fifty coolies for the carriage of the party's baggage had to be imported, as every available able bodied Lushai was employed on road making. Of the former, 200, chiefly Nepálese, were imported from Darjeeling, and the remainder were recruited from the Cachar district. The Nepálese turned out well, but the coolies from Cachar gave a lot of trouble, so that it was necessary to get rid of all of them except 60 Nágás and Kúkis who, though made to serve against their will, worked well, especially the latter. Arrangements have now been made to recruit all coolies required for the next field season from Darjeeling as the Cachar district is not to be relied on.

120. Transport difficulties added greatly to the cost of the season's work; rations were also expensive. Rice is the only grain obtainable in the Lushai Hills, and in limited quantities; the bulk of the food supplies was obtained from the Government contractor for the Police, Public Works Department, etc., and then only at high prices; all measures in connection with the rationing of the party were framed in accordance with the advice of the Superintendent, Lushai Hills, and the Deputy Commissioner of Cachar, both these officers being frequently consulted on all points relating to transport, rations, and other matters affecting expenditure.

121. As far as the health of the party was concerned several of the *khalásis* and coolies suffered from malarial fever owing to the nature of the country they were working in; dysentery and rheumatism of a mild nature were prevalent; thirty-three cases of mild scurvy occurred owing to want of fresh meat and vegetables.

122. The programme of work for the ensuing field season is as follows:—

(*a*) The completion of the first-class secondary series of triangulation commenced last field season. This work, starting from the base Sítapahár-Gilasari G. T. S. stations of the Eastern Frontier Series in the Chittagong Hill tracts, and extending northwards, will connect in the interior of the Lushai Hills with Sailam and Darlung hill stations on which the series was closed last season.

(*b*) Network triangulation will be carried on in sheets Nos. 163, 164 and 165.

(*c*) Detail survey on 1-inch scale of the area triangulated last season.

123. Lieutenant-Colonel J. R. Hobday, Officiating Deputy Surveyor-General, Revenue Branch, inspected the office of this party early in July 1898, and expressed his satisfaction of the work done, taking into consideration the new nature of work undertaken by the party for the first time, and the difficulties met with in the Lushai Hills. It will be noticed that no detail survey at all was completed this year; this was unavoidable, as from the nature of the country it was impossible to push triangulation on ahead sufficiently in this the first year of the survey to allow of the points being computed out, and the results plotted for the detail surveyors. This having been foreseen, almost all the sub-surveyors were temporarily transferred to other parties, where their services could be usefully employed.*

* The officer in charge reports very highly of Mr. Keating's work, and his satisfaction of the cheerful manner in which all the members of the party performed their duties under trying conditions. Mr. Waller Senior is especially mentioned for the zeal which he displayed; of the native establishment, Ram Singh, Abdul Haq and Syed Razi Hasan are specially mentioned.

BALÚCHISTÁN.

No. 15 Party.

124. Colonel Sir T. Holdich, K.C.I.E., C.B., R.E., was in charge from the 1st October 1897 till the 17th February 1898, when he retired from the department on attaining the age of 55, after which the charge of the party devolved on the several officers as marginally noted.

Personnel.

Colonel Sir. T. H. Holdich, K.C.I E., C.B., R.E., Superintendent, 1st grade, in charge up to 17th February 1898.
Lieutenant-Colonel R. A. Wahab, C.I.E , R.E., Superintendent, 2nd grade, in charge from 7th May 1898.
Lieutenant F. W. Pirrie, I.S.C., Officiating Deputy Superintendent, 2nd grade, in charge from 20th April to 6th May 1898.
Mr. T. E. M. Claudius, Extra Assistant Superintendent, 1st grade, in charge from 18th February to 19th April 1898.
" E. A. Wainright, Extra Assistant Superintendent, 4th grade.
" G. A. Knight, " " 5th "
" G. P. Tate, " " 6th "
Yusuf Sharif, Khan Bahadur, Sub-Assistant Superintendent, 1st grade.
Hira Singh, Rai Bahadur, " " 1st grade.
Mr. M. C. Petters, " " 2nd "
" H. C. H. Cooper, " " 3rd "
Ahmed Ali Khan, Khan Bahadur, " " 3rd "
5 Surveyors, 23 Sub-Surveyors, etc.

Lieutenant Pirrie was transferred to take over charge of No. 10 Party on the 20th September 1898, and Mr. Claudius of No. 7 Party on the 1st September 1898.

125. The party was divided into two detachments, one of which under Mr. Claudius was employed round Ráwalpindi, and took the field on the 22nd December 1897, closing work on the 14th April 1898, when it returned to recess quarters at Quetta. The other detachment under Mr. Tate was employed on a 1-inch survey of the hilly portion of Sind along the Balúchistán border. This detachment left Quetta on the 1st November 1897 and remained in the field until the 20th April 1898.

Triangulation was extended from the sides of the Indus series which runs through Sind. The instrument used was an 8-inch theodolite by Cooke and Sons. The country surveyed extends from the Indus near Sehwán westwards to the Sind border, and is for the most part open and cultivated. During the recess the computations of the season's triangulation were completed. The computations of the Kuram triangulation of 1894-95 were revised, and considerable progress has been made in the preparation of standard charts of triangulation and general reports, of which two have been completed and submitted for publication. The drawing of the fair maps has fallen somewhat into arrears, chiefly owing to the number of draftsmen taken during the recess season of 1897 for trans-frontier service.

126. The total outturn of the party is as follows:—

	Square miles.
Triangulation for 1-inch detail	1,430
Detail survey on 1-inch scale	1,857
" " 6 " "	114
Reconnaissance	8,224

127. The 16-inch survey of the Quetta cantonment was revised during the recess and brought up to date; the fair drawing is still in hand.

128. Next season the different surveys now in progress will be continued and a special survey on the 6-inch scale of the coal bearing area near Quetta, which has been commenced, will employ a small detachment for about 4 months.*

* The officer in charge reports very favourably of the whole party. Mr. Claudius deserves special mention for his able superintendence of the party during the absence of the Superintendent on field service; Messrs. Petters and Cooper both promise to become thoroughly useful assistants. Of the native establishment, Asghar Ali Beg, Khan Bahadur, Ahmed Hasan, and Tulsi Ram deserve special mention.

PUNJAB SURVEY

1897-98

NO. 18 PARTY.

INDEX TO THE SURVEY OPERATIONS IN THE HIMALAYAS

JUMMOO
DALHOUSIE
CHAMBA
BARA BANGAHAL
GURDASPUR
HOSHIARPUR
AMRITSAR DISTRICT
JULLUNDUR DISTRICT
HOSHIARPUR DISTRICT
KOTGARH
SIMLA
NAHAN
UMBALLA
DEHRA DUN
SAHARANPUR DISTRICT
64 N.W.
64 S.W.
63 N.W.
63 S.W.

REFERENCES.

	2" = 1 Mile	4" = 1 Mile	1" = 1 Mile
Surveyed during previous Seasons			
Do. 1897-98			
Area Triangulated in advance			
Do. 1897-98			
Simla-Kalka Road Survey, published on Scale 8 Inches = 1 Mile			
Approximate limit of Hill tracts			

NOTES.

The figures and lines in outline represent the numbers and limits of the Engraved sheets of the Indian Atlas.

The numerals 246, &c., indicate the Standard sheets.

Scale of Miles

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dun.

No. 195-S. 98.

HIMÁLAYAS, PUNJAB.

No. 18 Party.

129. Mr. L. J. Pocock remained in charge of the party throughout the year. except for sixteen days, during which time Lieutenant-Colonel R. A. Wahab, R. E.; held charge.

Personnel.

Lieutenant-Colonel R. A. Wahab, R. E., Superintendent, 2nd grade, in charge from 1st to the 16th November 1897.
Mr. L. J. Pocock, Extra Assistant Superintendent, 1st grade, in charge fro 1st to 31st October and from 17th November 1897 to 30th September 1898. m
Mr. C. D. Potter, Extra Assistant Superintendent, 4th grade.
" W. Robert, " " " 5th "
" G. E. Parker, " " " 5th " from 17th January 1898.
" W. A. Fielding, " " " 6th " to the 2nd November 1897.
" J. O. Greiff, Sub-Assistant Superintendent, 2nd grade, from 19th October 1897.
" W. M. Gorman, " " 2nd "
" E. J. Biggie, " " 2nd "
" C. E. C. French " " 3rd "

Surveyors and Sub-Surveyors.

Shah Nasiruddin, Ram Saran, Garjman Rai, Amir Sing and 32 others.

130. The work of the party, as in former years, comprised the topography of British tracts on the 4-inch scale; of the Native States on the 2-inch scale, and of all demarcated forests, wherever situated, on the 4-inch and 2-inch scales.

131. The localities that were under survey were—

(i) The Kángra district and Kullu sub-division of that district, on the 4-inch scale.

(ii) The Native States of Mandi, Suket, and Simla Hill States, on the 2-inch scale.

(iii) Special surveys of the forests in the Sirmúr State, and in the Simla Hill States, on the 4-inch and 2-inch scales.

(iv) Triangulation in advance of topography in the Simla Hill States, in the districts of Hoshiárpur and Kángra and in the snowy regions of the Kullu sub-division of Kángra.

(v) The classification of forest growth and soils *pari passu* with the topography in British tracts, and special forest surveys.

(vi) The large scale survey, 48 inches=1 mile, of the town of Náhan in Sirmúr, carried out at the special request and cost of the Sirmúr State.

(vii) Some revisionary work along the left bank of the Jumna river where it runs through Sirmúr, required on account of change of course of river.

132. All of the above operations, except the last, were in continuation of the previous season's work. The system of classification of forest growth and soils was continued in Kullu, Sirmúr and Kángra, and local officers as before, were supplied with ferrotyped reproductions of the field work, in advance of the publication of the 4-inch sheets. In keeping with the arrangements made last year by Captain Robertson, the preparation of these traces of classification was done once for all in the field, for reproduction, and so the necessity for redrawing them in recess was avoided.

133. The party was divided into five sections, the head-quarters being in charge of the Executive Officer, and the other four in charge of Messrs. C. D. Potter, W. Robert, J. O. Greiff and W. M. Gorman, the first three supervising squads of sub-surveyors, and the last named carrying on the triangulation in advance. These detachments left recess quarters on various dates between the beginning of October and the end of November, returning to recess quarters during the period between the middle of April and beginning of July.

134. The outturn of the field season's work was as follows:—

	Square miles.
(*a*) Triangulation in the Simla Hill States and in Kullu .	663
(*b*) Detailed survey on the 4-inch scale—	
Kángra	112
Kullu	89
Sirmúr	116
	317

(*c*) Detailed survey on the 2-inch scale —

	Square miles.
Mandi, Suket, and Simla Hill States	235
Sirmúr State	24
	259

The surveys of the following forest blocks are included in the areas shown above :—

	Number of blocks.	Area in square miles.
In Sirmúr	48	135·5
„ Kullu	4	3·2
„ Kángra	15	7·4
TOTAL .	67	146·1

135. The usual tests were applied by the Executive Officer and assistants, who constantly visited some one or other of the squads. During the year 41 plane-table sections were thus examined, the work proved of good quality in all cases.

136. The triangulation was carried on in the districts of Kángra and Hoshiárpur, the Native State of Biláspur, the Simla Hill States, and in the snowy regions of Kullu, where stations over 17,000 feet were visited.

The results prove that the observations are good and Mr. Gorman deserves credit for his good work in the high altitudes above mentioned.

137. The cost rates per square mile of the various operations are as follows :—

	R
Triangulation	11·5
Average of all detail survey, 4-inch	107·5
Ditto 2-inch	53·4

The cost of the triangulation is much below last year's, which was nearly R30 per square mile.

The cost rates for the detail survey are in excess of those quoted last year, for which there are the following reasons : (1) The Kullu detachment lost the services of three of its best and most experienced surveyors, who were selected for frontier and exploration work with the Malakand and Mohmand expeditions and elsewhere ; (2) the very unexpected and continuously unfavourable weather for nearly a month during the spring months in the snowy regions ; (3) the area surveyed in Kángra was of a very difficult nature and forest clad ; (4) there was a paucity of old hands in this detachment. All these causes tended to decrease the area and therefore to raise the cost rates.

138. The country surveyed in Sirmúr on 4-inch and 2-inch scales being mostly open, admitted of survey by interpolation, and progress was easy, and all testing was done by *in situ* fixings. The 48-inch survey of the city of Náhan was tested by actual measurements of the various buildings shown on the plane-tables, a large percentage of each being tested. It should be stated that during the season under report a change of scale from 4-inch to 2-inch in Sirmúr was decided on. The State was addressed on the subject on the 28th June 1897, when it was proposed that a final decision should be arrived at whether the high and generally bare ground should be surveyed on the 4-inch, as are the other portions of Sirmúr that are covered with forest. The contribution of the cost of a 4-inch survey by the State was R40 per square mile, and it was suggested that if the scale were reduced to 2 inches the contribution towards unsurveyed ground would be R20 and over ground already surveyed and published on the 2-inch scale R30 per square mile. The State decided on accepting the proposals, and accordingly all future surveys in Sirmúr will

be executed on the smaller scale. This will very considerably quicken the work and lessen the cost.

139. The large scale survey of Náhan town was continued, but on account of the intricate nature of the work could not be completed. It is intended to have a series of spirit levels carried over the ground so as to leave suitable bench marks, which will be of much use in case of any engineering projects being undertaken hereafter by the State Engineer.

140. In the snowy regions of Kullu proper the country plane-tabled is, in general character and in physical aspect, in every respect the same as described in last season's Report, being, if possible, more wild in its solemn grandeur and bleak beyond description. The great peaks of the main ridge dividing Kullu proper from Spiti attain an average altitude of nearly 19,000 feet above sea level, at the base of which lie several glaciers, some being many miles in length but narrow in width, the two largest dropping down to an elevation of 11,500 feet. The forests surveyed are second class and these extend far up the main streams to an elevation of 12,500 feet above sea level, and consist chiefly of stunted trees of *bhúj*, *tós* and rhododendron, and higher up, in isolated patches, juniper bushes are found.

141. The 2-inch work in the Native States of Mandi, Suket, and the Simla Hill States has its limits, on the north, marked by the Naina Devi range, to the south by the low Siwálik range, broken by the Sutlej river, and the high Jorjorn range immediately above the low ground of the *Dún* of Nálagarh on the east. The whole of this, which is on an average only 1,000 feet above sea level, is of an extremely intricate nature, being cut up by numerous small streams and ravines, with sheer precipitous banks of a conglomerate formation and about 100 feet in height.

142. In Kángra the country surveyed embraced chiefly the watershed between the Chakki and Chhamach *khads* together with a small area of the low hills to the south of the latter. This country, as a whole, presented a confused undulating mass of hills and water courses, rising in succession as they approach the bold clearly defined range that bounds Kángra on the north and north-west. The low hills south of the Chhamach spread out from their flat topped summits in spurs of even slopes and are assiduously cultivated. Owing to the remarkable flatness of this mass of hills and their uniform elevation they were difficult to survey, necessitating innumerable plane-table fixings in order to see all the topographical detail. In places also they are thickly wooded, especially on the flanks of the spurs, and all these disadvantages combined, rendered the progress of the work slow. In some parts of the work, however, the ground presented a marked difference to that just described. As you approach the mountain range that lies to the north, and which rises up to 17,000 feet, the country is of greater elevation and the hills begin to assume larger and bolder features. The general aspect is more rugged and rocky and the shrubbery that clothes the lower hills gives place to tall pines and trees of kindred growth. From its structure and formation the country is naturally less cultivated and has a smaller number of inhabitants.

143. The further instruction in surveying during a two years' course of Native Soldier students from the Thomason Civil Engineering College forms one of the duties of this party. One man, Havildar Ude Ram of the 6th Bengal Light Infantry, completed his course in July and returned to his regiment. The Naik of the 44th Gurkhas who joined the party last October will remain a year longer. In lieu of Ude Ram another man, it is expected, will join the party very soon. Ude Ram and Madho Ram have both shown aptitude for the work and the Havildar gave much satisfaction.

144. Steady progress has been made with the drawing of the fair maps and forwarding of them for publication. During the year 34 sheets on the 4-inch and 7 on the 2-inch scale and one triangulation chart have been sent for publication, as also the 6-inch sheets (2) of the revised survey of the Mahásu extension survey. Also 16 forest traces showing the classification of soils and forest growth have been prepared and sent for ferrotype copies, for supply to Forest Officers. It will thus be seen that the mapping has been well advanced, a total of 44 sheets of different scales having been submitted for publication, besides the examination and passing of 20 proofs, and the same number of specimens for colorists.

145. In order to deal more rapidly with the arrears of mapping, the officer in chargeha arranged, with the consent of the Superintendent Trigonometrical Surveys, to make each field detachment responsible for the fair drawing, during the recess, of the sheets surveyed during the field season, the arrears, if any, being handed over to the permanent drawing establishment attached to the party. It is thus hoped to clear off the arrears during the next 18 months. The party has however always been much hampered in its efforts to keep abreast of the mapping, by the constant requisitions for special surveys for various purposes, all of which are urgently required, and the drawing of which greatly impedes the completion of the sheets of the regular survey.

146. Considering the disadvantages under which the party worked in having so many of its best men temporarily withdrawn, the season's work shows a good outturn and does not compare unfavorably with that of previous years.

147. His Highness of Sirmúr, as well as all District and Forest Officers were most helpful in ensuring the progress of the work, and the Executive Officer acknowledges the same with much pleasure.

148. The proposed programme for this party for season 1898-99 consists of the continuation of 4-inch topography in Kullu and Kángra ;| topography on the 2-inch scale will also be carried on in the Native States of Mandi, Suket and Sirmúr and the Simla Hill States. As noted above, all future surveys in Sirmúr will be executed on the 2-inch scale, including the State forests.

149. The party was inspected by the Surveyor-General in July, and by the Superintendent Trigonometrical Surveys, in August, and both these officers expressed their unqualified approval of the state in which they found the party.*

FOREST SURVEYS.

MADRAS PRESIDENCY.

Nos. 9 and 19 Parties.

150. Under orders from the Surveyor-General the amalgamation of Nos. 9 and 19 Parties took place on the 1st September 1897, and the programme for 1897-98 has been carried out.

Personnel.

Captain H. A. Denholm Fraser, R. E., Deputy Superintendent, 2nd grade, in charge up to 7th April 1898.
Lieutenant A. Mears, I. S. C., Assistant Superintendent, 2nd grade.
Mr. A. G. Wyatt, Extra Assistant Superintendent, 2nd grade, up to 26th April 1898.
" C. F. Hamer, " " 3rd grade, in charge from 8th April 1898.
" H. Todd, Extra Assistant Superintendent, 3rd grade.
" R. Todd, " 4th "
" C. George, " 6th "
" W. C. G. Barckley, Sub-Assistant Superintendent, 1st grade.
" J. H. S. Wilson, " 2nd grade.
" M. J. Sheehan, " 2nd "
" J. O'B. Donaghey " 2nd "
67 Surveyors, Sub-Surveyors, etc.

151. The double party was employed during the season on the 4-inch survey of forest reserves in Salem, South Arcot, North Coimbatore and Kurnool districts ; triangulation and traversing was also carried out in these districts, and triangulation in Cuddapah was commenced this season.

152. The triangulation carried out in North Coimbatore district amounted to 1,711 square miles, which was executed by Lieutenant Mears, Mr. J. H. S. Wilson and Surveyor Govind Raju Mudaliar. As reported before, the previous year's triangulation carried out by Mr. Barckley being defective in many ways, it was found necessary to triangulate the whole of it again and Mr. Wilson was deputed to take up the work.

153. In Kurnool district the triangulation was extended northwards by Mr. R. Todd from the previous season's work ; the area triangulated was 720 square miles, which may be looked upon as satisfactory considering the difficult and inaccessible nature of the ground.

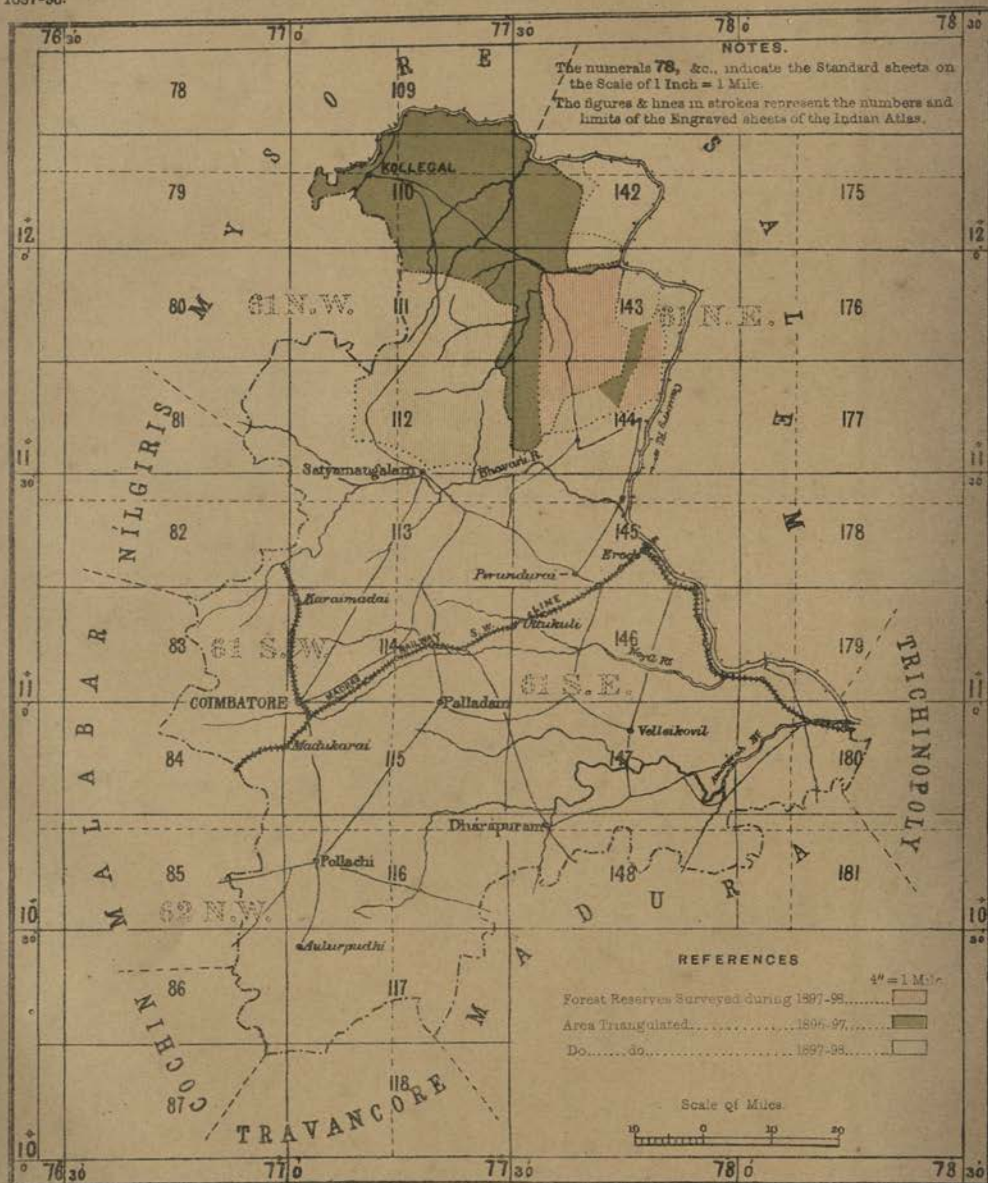
154. The triangulation in Cuddapah district was commenced this season in the extreme north but could not be completed on account of Mr. Barckley being incapacitated by illness in March. The outturn of 900 square miles is

* Mr. Pocock reports very highly of the services of Messrs. Potter and Robert, and adds that Messrs. Parker, Greiff, Gorman, Biggie and French rendered excellent service.
Of the subordinate establishment the following are specially brought to notic :—Amir Singh, Garjman Rai, Narain Dutt, Fateh Mahomed, Sheopal Misser, Sanker Singh, Ramsaran, Abdul Kibria and Khusi Nand.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE COIMBATORE DISTRICT.

1897-98. Nos. 9 & 19 PARTIES



Reg. No. 317 S. I. D.—Mar. 99—550.

Photo., S. I. O., Calcutta.

No. 450-S. 99.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE NORTH ARCOT DISTRICT.

1897-98. Nos. 9 & 19 PARTIES.

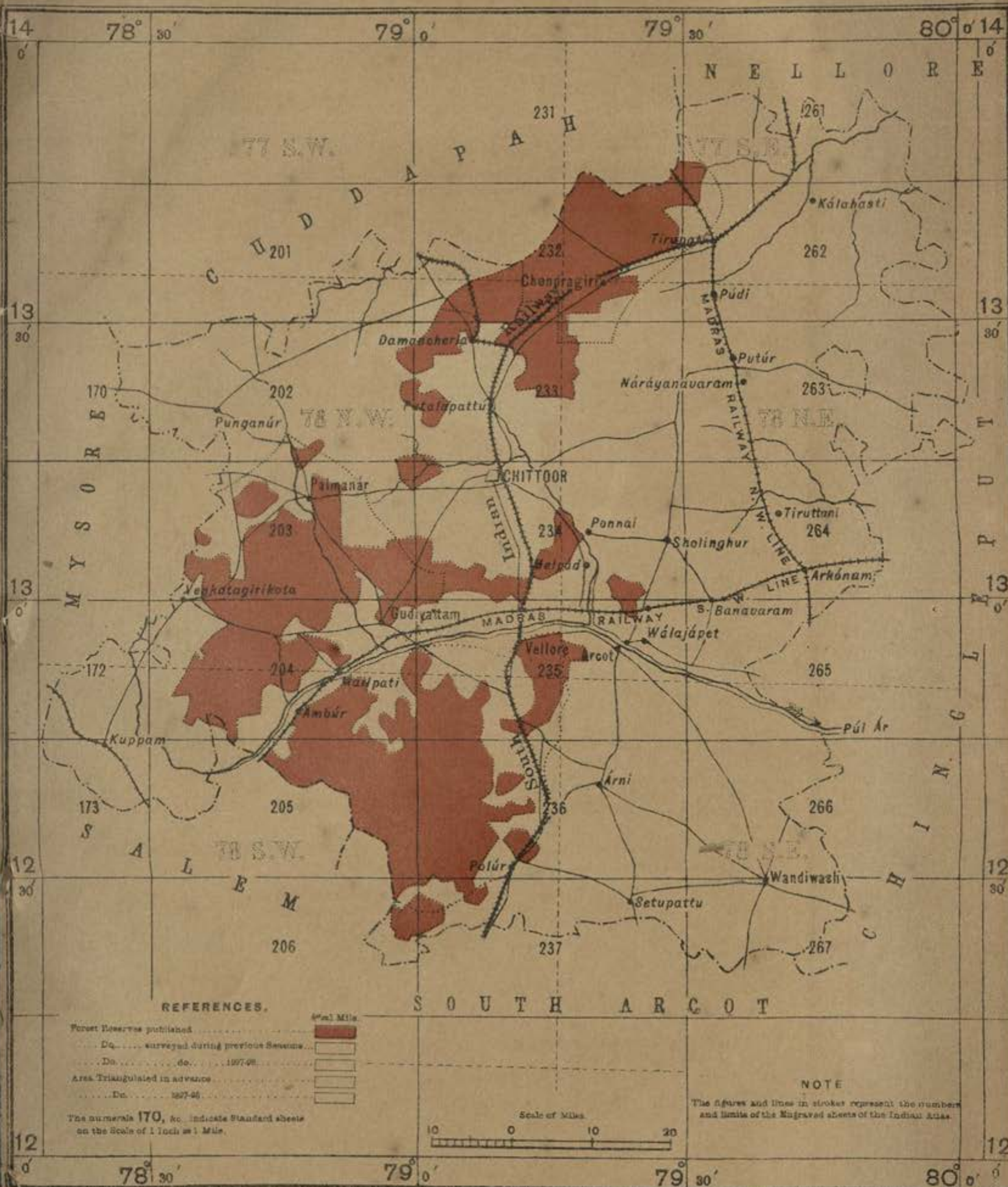


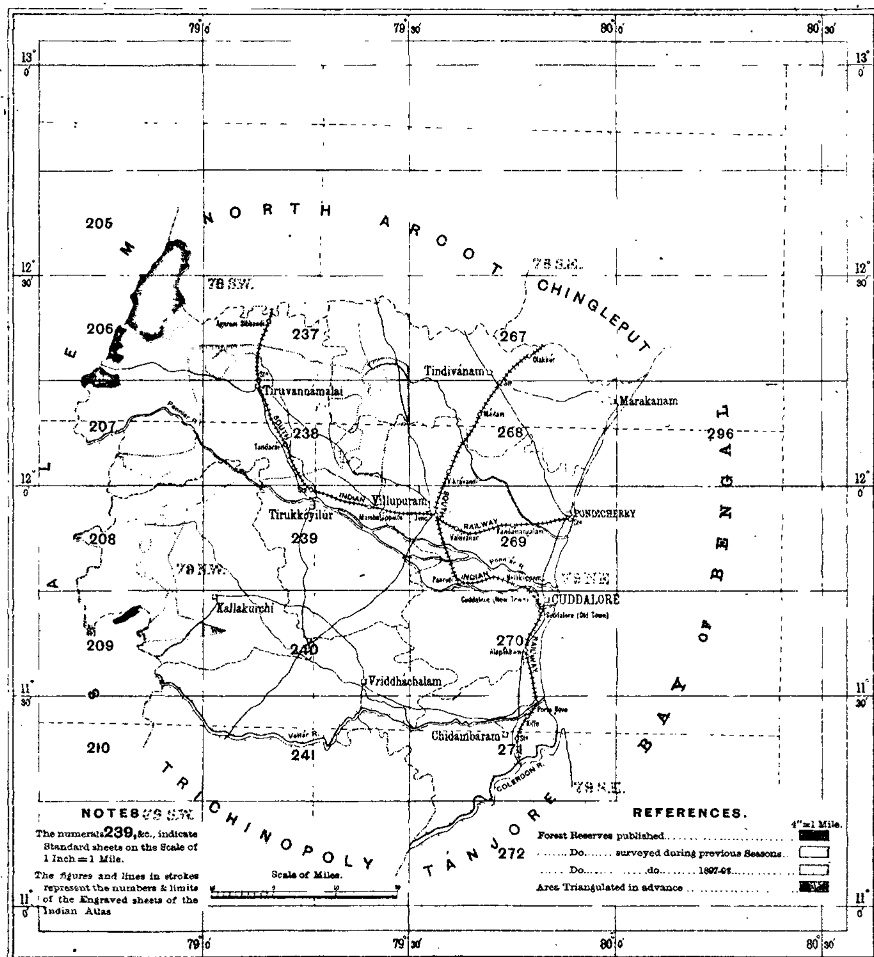
Photo., S. I. O., Calcutta.

No. 452-S. 99.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE SOUTH ARCOT DISTRICT.

1897-98. Nos. 9 & 19 PARTIES

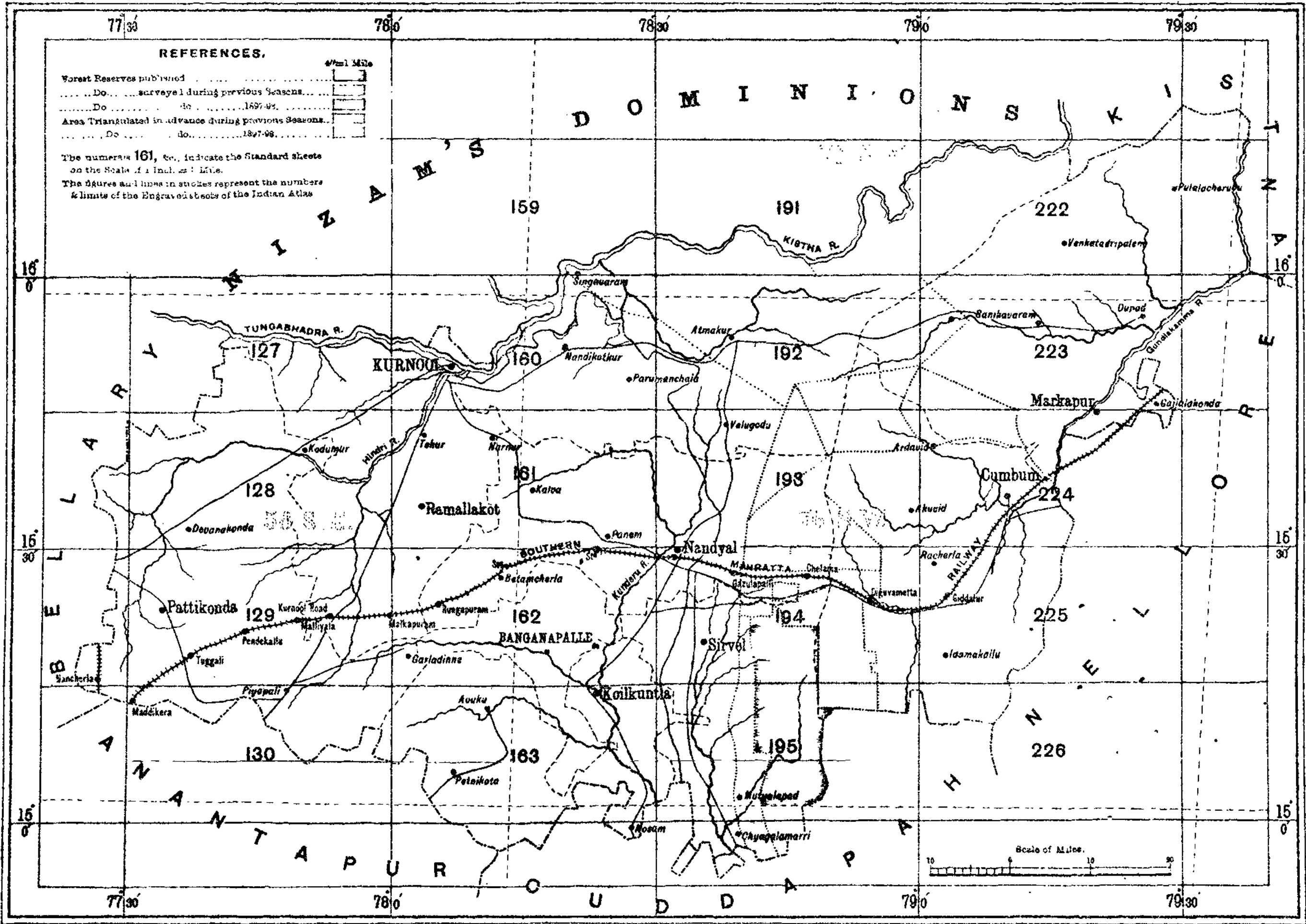


Reg. No. 327, S. I. D.—Mar. 99—54. Photo., S. I. O., Calcutta.

No. 451-S. 99.

1897-98. Nos. 9 & 19 PARTIES

INDEX TO THE FOREST SURVEYS IN THE KURNOOL DISTRICT.



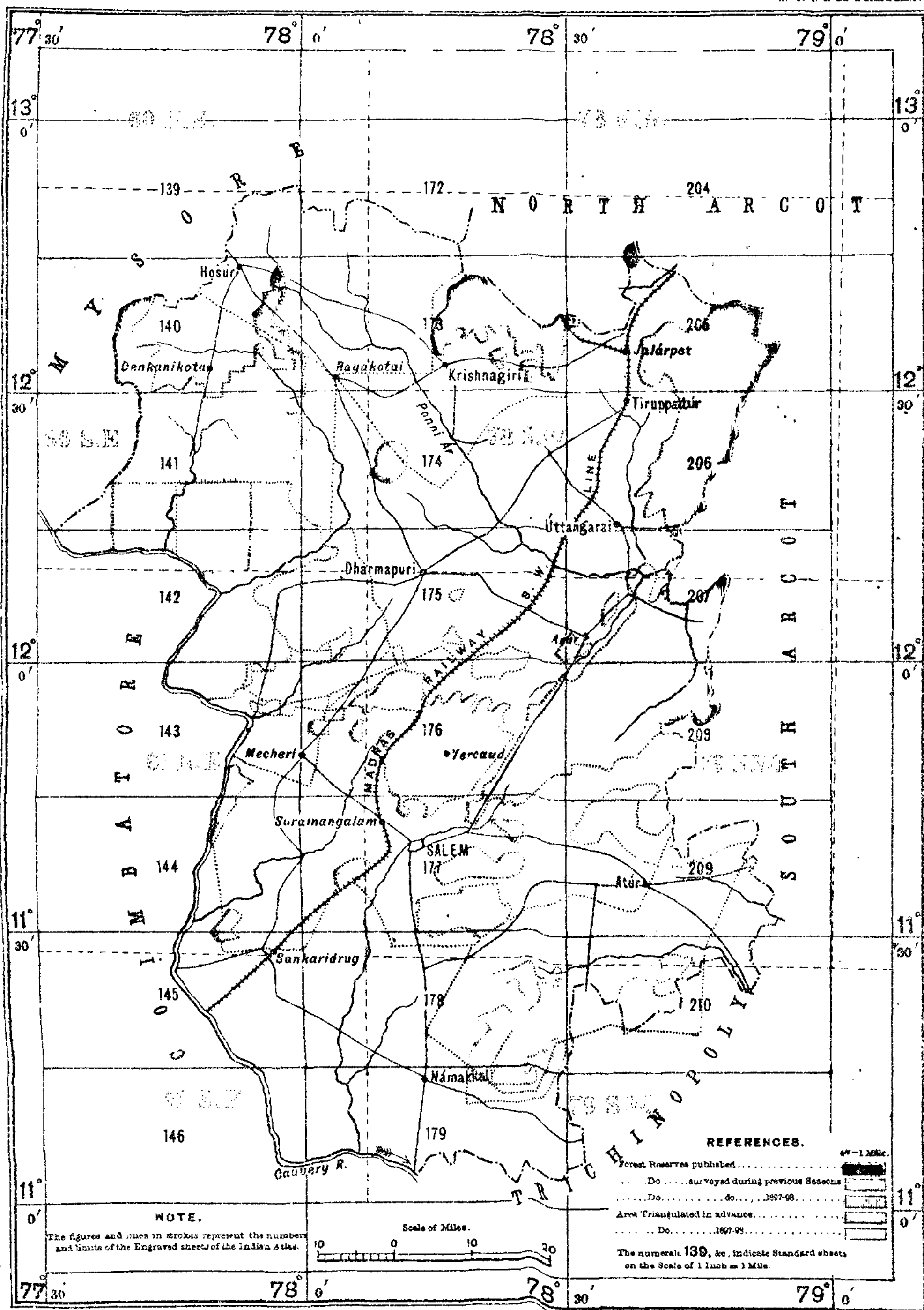
Reg. No. 327, S. I. D.—Mar. 99—550. Photo., S. I. O., Calcutta.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE SALEM DISTRICT.

1897-98.

Nos. 9 & 19 PARTIES.



Reg No. 327, S. I. D.—Mar 23—99.

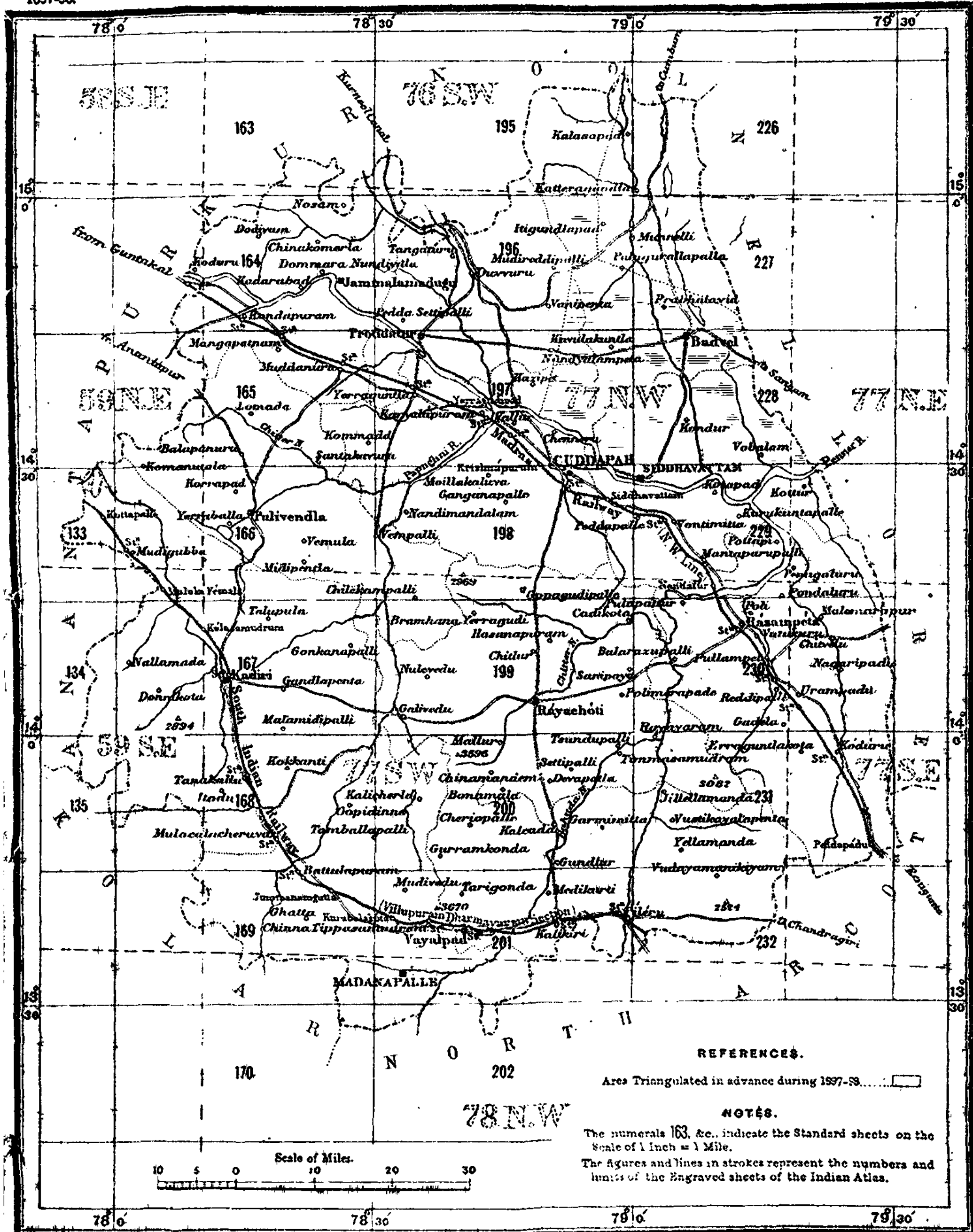
Photo., S. I. O., Calcutta.

No. 463-S. 99.

MADRAS SURVEY.

INDEX TO THE FOREST SURVEYS IN THE CUDDAPAH DISTRICT.

1897-98. Nos. 9 & 19 PARTIES.



Ret. No. 63, S. I. D.—Mar. 99.

Photo. S. I. D., Calcutta.

No. 439-S. 99.

good and is an improvement on the previous season's work done by this officer in Coimbatore district.

155. The traversing carried out during the season amounts to 712 linear miles in Salem, South Arcot, North Coimbatore, Kurnool and Cuddapah districts. Traverse plots of district and *táluk* boundaries have been obtained from the Madras Revenue Survey and utilized.

156. The area of topography for the year amounts to 1,050 square miles; it would no doubt have been still greater had it not been for the exceedingly intricate and difficult nature of the ground, the unusually wet weather experienced at the beginning of the season, the amount of sickness which prevailed, especially amongst the native establishment, and, lastly, owing to the large number of young hands new to the work.

157. The country surveyed (except in South Arcot) is everywhere mountainous and in most parts covered with dense jungle. The average elevation of hill tops exceeds 3,000 feet above sea-level, the highest point, 4,250 feet, being on the Kalráyan Hills of Salem district. On most of these hills (except in Kurnool) there are numerous villages with a considerable, though scattered, area of cultivation. As the demarcation of these villages has not yet been carried out, the whole area has been surveyed, and the limits of cultivation existing at the time of survey have been shewn: this procedure was adopted for the Shevaroy, Jávidi and Kalráyan Hills in previous seasons. The whole of the work was examined by the section officers concerned by *in situ* fixings or chain measurement as was found most suitable. The accuracy of the work was very satisfactory.

158. There were two deaths from cholera; a sub-surveyor died in Kurnool and a *khalási* in South Arcot. Several men of the native establishment had to be invalided.

159. During the recess the various computations have been brought up to date, the large amount of triangulation entailing heavy work on the computers. The fair mapping of 53 sheets has also been completed, 17 sheets are to be held back from publication for resurvey of boundaries wrongly demarcated by the forest officials, and 6 sheets, the survey of which has not been completed, will be held over till next year.

160. The actual expense, including cost of instruments for the survey year ending 31st August 1898, is R1,29,293, or an average of R119 per square mile.

161. This high rate is chiefly due to the following causes:—

(*a*) The extra expense in Kurnool district where the menial establishment had to be increased by 30 per cent.

(*b*) Extra travelling allowance by 50 per cent in Kurnool and Coimbatore to European assistants and native staff.

(*c*) The expense incurred in carriage of provisions for most of the squads in the districts of Kurnool and Coimbatore.

(*d*) And the expense incurred in keeping up a computing section in Coimbatore district.

162. The programme for the ensuing field season comprises the completion of the triangulation in North Coimbatore, the Nallamalai Hills of Kurnool, and a portion of the incompleted work of last field season in Cuddapah; this, it is hoped will be carried out by Mr. R. Todd and native surveyors. The topography will be extended in Kurnool and North Coimbatore and commenced in Cuddapah. Traversing will also be continued in these three districts.

163. The party was inspected by the Deputy Surveyor-General in August.

164. The District Forest Officers of Salem, South Arcot, Kurnool, and Coimbatore visited the office at Bangalore between April and July for the purpose of verifying the maps. All omissions and corrections as far as possible have been made. Fifteen sheets of Salem district have been held over from publication till next year on account of faulty demarcation and clearing of forest boundaries.*

* The officer in charge reports that Messrs. C. F. Hamer, H. Todd, and C. George have worked with energy and good will, and that Messrs. J. H. S. Wilson, M. J. Sheehan, and J. O'B. Donaghey have rendered good service.

The surveyors and sub-surveyors as well as the soldier surveyors, with a few exceptions, are well spoken of. Writers Tara Prasanna Roy and Pulin Bihari Roy have also given satisfaction.

BOMBAY PRESIDENCY.

No. 17 Party.

Personnel.

Captain P. J. Gordon, I. S. C., Deputy Superintendent, 1st grade, in charge from 7th June 1898.
Mr. C. E. Tapsell, Extra Assistant Superintendent, 3rd grade, in charge up to 6th June 1898.
Mr. S. F. Norman, Extra Assistant Superintendent, 6th grade.
Mr. C. A. Norman, " " 6th "

Surveyors and Sub-Surveyors.

G. R. Bhopatkar, R. V. Joshi, Govind Gopál and 43 others.

165. Mr. C. E. Tapsell held temporary charge of this party throughout the field season and until the 7th June when Captain Gordon, I.S.C., on return from furlough, was appointed to the charge of the party; the actual field work was therefore executed under Mr. Tapsell's supervision.

166. The party continued the survey of the forest-reserves in the northern, central and southern circles of the Bombay Presidency on various scales, these operations comprising :—

(1) *In the Northern Circle.*—Preliminary triangulation in Thána. Detail survey on the 8-inch scale of the teak reserves in Thána (Máhím *táluka*).

(2) *In the Central Circle.*—Advance triangulation in Násik. Detail survey on the 8-inch scale of forest reserves in Násik (Igatpuri *táluka*). Detail survey on the 16-inch scale of *bábul* reserves in Ahmednagar (Ráhuri and Kopargaon *tálukas*) and Násik (Niphád and Yeola *tálukas*).

(3) *In the Southern Circle.*—Advance triangulation in Kolába. Advance traversing in north Kánara (Sirsi and Siddápur *tálukas*). Detail survey on the 8-inch scale of forest reserves in Kolába (Roha *táluka*) and on the 4-inch scale in North Kánara (Sirsi *táluka*).

167. The field season lasted from the beginning of December to the end of May.

168. The following table shows the total cost rates and area surveyed for the last three years :—

Description of work.	Cost-rates per square mile.			Area surveyed in square miles.		
	1895-96.	1896-97.	1897-98.	1895-96.	1896-97.	1897-98.
	R	R	R			
Triangulation	5·4	7·4	7·9	505	1,376	718
Traversing	25·5(*a*)	14·3(*a*)	16·7(*a*)	165(*a*)	188(*a*)	164(*a*)
Topography, 4-inch	66·8	77·6	60·2	829	522	444
8 "	122·4	135·7	178·9	108	168	204
16 "	130·0	156·1	154·5	15	33	29

(*a*) Linear miles.

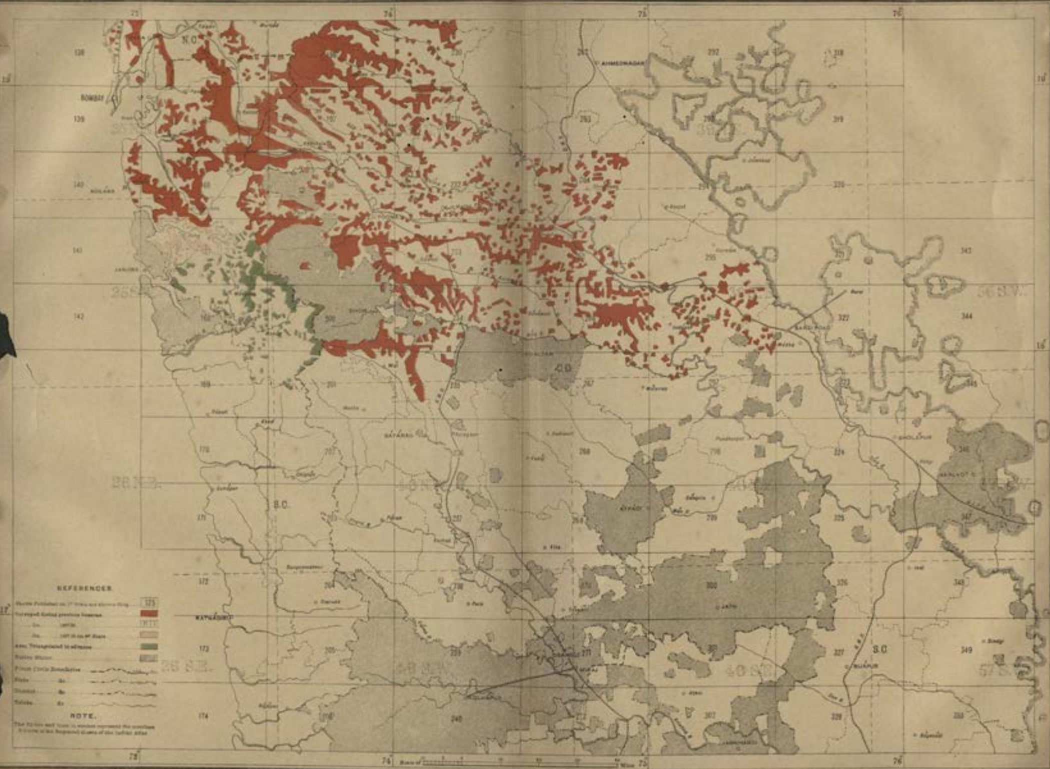
169. The outturn of triangulation and traversing need not be compared as no attempt has been made to triangulate or traverse a larger area than is actually required as a basis for the topography of the ensuing season. As regards the outturn of topography, in order to obtain a just comparison in a party where surveys on several scales are being done at the same time, it is necessary to form a scale of relative values for the different descriptions of survey. This cannot be done with any great degree of accuracy but it may be assumed in the districts where the party is working at present that a square mile of 8-inch or 16-inch survey is equal to three of 4-inch.

Applying this scale to the areas of topography for the last three years the following results are obtained :—

	Square miles.
1895-96	1,198
1896-97	1,125
1897-98	1,143

BOMBAY SURVEY.

1897-98. INDEX TO THE FOREST SURVEYS IN PORTIONS OF THE NORTHERN, CENTRAL, & SOUTHERN CIRCLES. No 17 PARTY.



No. 430-S. 99.

BOMBAY SURVEY.

INDEX TO THE FOREST SURVEYS IN PORTIONS OF THE NORTHERN & CENTRAL CIRCLES.

1897-98. No. 17 PARTY.

BROACH

NANDOD

DHULIA

NASIK

N.C.

37 N.E.

37 S.E.

38 N.E.

REFERENCES.

NOTE.

No. 429-S. 99.

BOMBAY SURVEY.

1897-98. INDEX TO THE FORFEST SURVEYS IN PORTION OF THE SOUTHERN CIRCLE No. 17 PARTY.

REFERENCES.

Sheets Published on 1" Scale are shewn thus 125

Surveyed during previous Seasons

Area Traversed in advance

Native States and Goa

Forest Circle Boundaries

State do

District do

Taluka do

NOTE.

Scale of Miles

27 N.E.

41 N.W.

41 S.W.

41 S.E.

42 N.W.

42 N.E.

42 S.W.

42 S.E.

58 N.W.

58 S.W.

BELGAUM

MUDHOL

KALADGI

DHARWAR

170. Although the cost rates of triangulation appear much the same as for last season they are in reality considerably less. Area as a test of triangulation is misleading, especially where the areas triangulated are scattered, as is the case in this party. The number of stations of observation forms a much better standard for comparing cost rates. The cost for each station of observation for the last three years is:—

	R
For 1895-96	27·6
„ 1896-97	50·8
„ 1897-98	22·4

The decrease in the cost is chiefly due to the triangulation having been entirely executed by native agency.

171. The cost rates of 4-inch surveys also show a decrease, while those of 16-inch surveys are practically the same as for last year.

The cost rates of 8-inch surveys unfortunately show a considerable increase. This is attributable partly to the more difficult nature of the country under survey in Násik and Kolába, but principally to the death of several trained and experienced surveyors from plague since last field season. The places of these men had to be filled by apprentices, who were unable to produce nearly such a large area of topography, and it must be borne in mind that it is on area principally that cost rates depend.

172. The total cost of the party is R6,230 less than for 1896-97, as will be seen in the table below—

Description of work.	Total cost.		
	1895-96.	1896-97.	1897-98.
	R	R	R
Triangulation Traversing Topography, 4-inch „ 8 „ „ 16 „	77,368	82,337	76,107

This decrease is chiefly due to a saving in the cost of supervision, Mr. Tapsell having officiated in charge of the party for eight months, in addition to his other duties.

173. The work was thoroughly examined and tested while in progress.

174. During the recess the fair mapping and computations of the season's work have been completed, 125 sheets on the various scales having been prepared for the press. All arrears of mapping have been taken up and it is hoped that by the end of next field season they will be out of hand. All maps submitted to the Bombay Government Photozincographic Office have been published.

175. The health of the party on the whole was good with the exception of the usual cases of fever in the Kánara detachment. Three surveyors have died of plague since the submission of last report, but these casualties all occurred before the party took the field.

176. The programme for the ensuing field season is as follows:—

Triangulation in Násik and Thána.
Traversing in North Kánara.
4-inch surveys in North Kánara.
8-inch „ in Kolába, Násik and Thána.
16-inch „ in Ahmednagar and Sholápur.

177. The recess office was inspected towards the end of the recess by the Surveyor-General.*

LOWER BURMA.

No. 20 Party.

178. This party was under the charge of Lieutenant A. H. B. Hume, R.E., throughout the year. Its programme for the season comprised:—

Personnel.

Lieutenant A. H. B. Hume, R. E., Officiating Deputy Superintendent, 2nd grade in charge.
Mr. W. A. Wilson, Extra Assistant Superintendent, 1st grade, retired 4th June 1898.
" C. W. Wilson " " " 5th "
" A. George " " " 6th "
" A. Ewing " " " 6th "
" H. A. Charrier, Sub. " " 2nd "
55 Surveyors, Sub-Surveyors, etc.

(1) Traverse survey in advance of the East Yoma forest reserve, Thayetmyo division, and of the Shwelaung, Kodugwe and Salu reserves and unreserved forest lands neighbouring on the Pegu division.

(2) Detail survey on the 4-inch scale of forest reserves of the Pegu division and of the Shwegyin division and on the 2-inch scale of unreserved forests on the Yenwe river adjoining the latter.

179. The party left recess quarters at Bangalore about the middle of November and commenced field work in the first week of December.

The return to recess quarters was made in the first week in June 1898. Owing to the unhealthiness of the forests in the early part of the season, and the early breaking of the monsoon in May or April it is hard to get much more than five months' work in the field which greatly tends to increase the cost rate.

180. The outturn for the season is as follows:—

	Square miles.
Traversing	773
Topography, 4-inch	406
Ditto, 2-inch	118

181. No triangulation in advance was carried on as it was already completed for this district and was sufficient for 2 or 3 seasons' topography.

182. The traverse work was conducted by Mr. W. A. Wilson in the field, and on his retirement by Mr. C. W. Wilson; a good outturn was completed showing a total number of linear miles equal to last year's with the same number of men employed and covering a considerably larger area. The work was checked by 124 sun azimuths, giving good results.

183. The detail work was divided into two sections, one under Mr. George in the Shwegyin division, and the second under Mr. Ewing in the Pegu division. On account of the large increase to the party in transfers from other parties and apprentices much training work was required. Mr. George being new to the work of the party was given men of some experience and only two of the apprentices. Mr. Ewing had among his section 8 sub-surveyors from other parties, Mr. Davies and 6 apprentices all requiring training. This training of sub-surveyors will now cease as the Dehra Training School gets into full swing. Mr. Charrier was employed on 4-inch work, and on Mr. George leaving on account of illness he took charge of that detail section. The assistants tested the plane-tables by *partál* lines, and the Officer in charge visited the camps and men at their work and tested some of the boards.

The classification of forests and soils was continued.

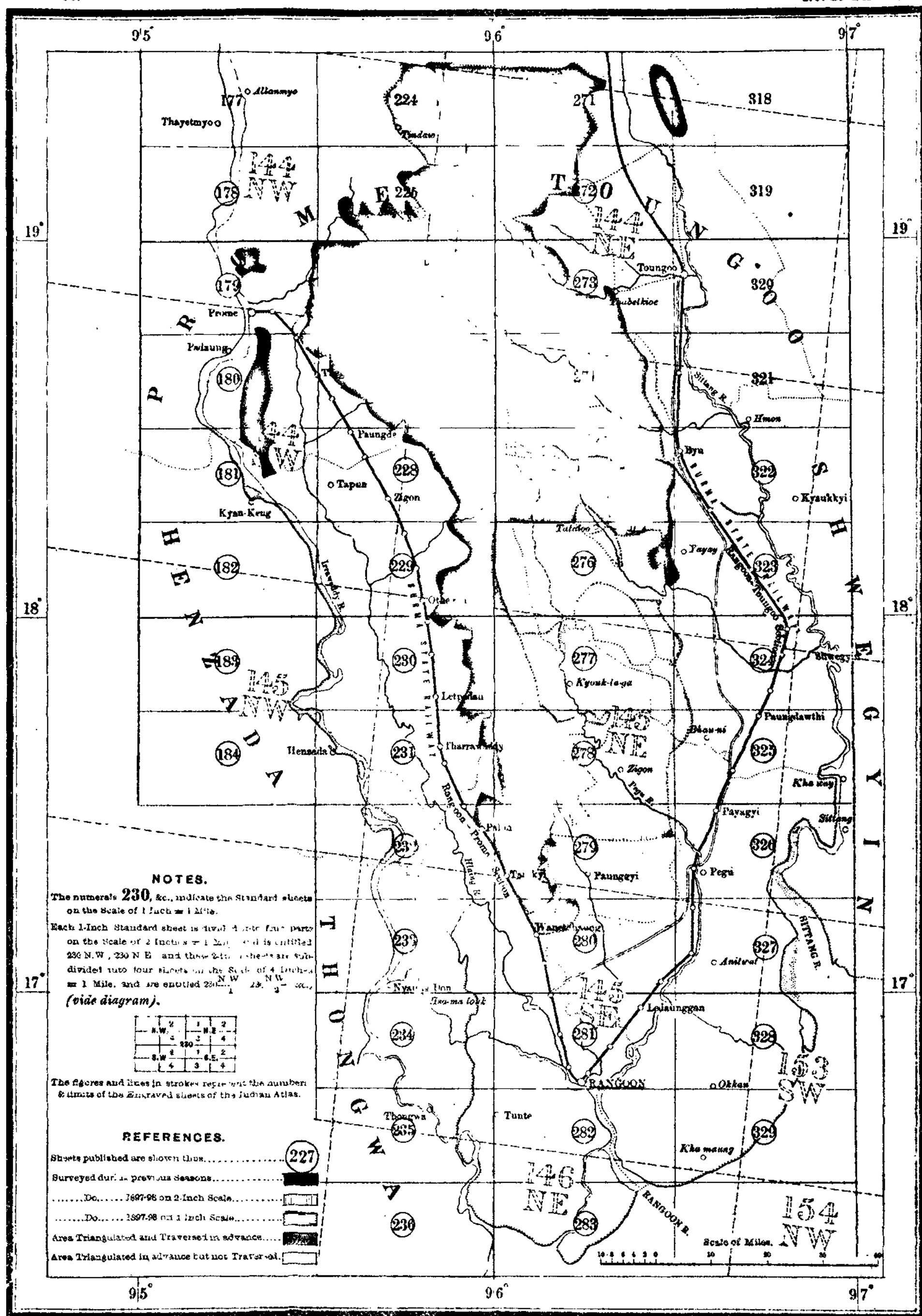
184. The outturn of both 4-inch and 2-inch work is a little larger than last year.

* The Assistants in charge of camps performed their duties satisfactorily, and Surveyors G. R. Bhopatkar, Govind Gopál, Hari Ramchandra, Mashud Khan, and L. B. Lele may be mentioned as having done good work.

BURMA SURVEY.

INDEX TO THE FOREST SURVEY IN LOWER BURMA.

1897-98. No. 20 PARTY.



Ref. No. 320, S. I. D.—Feb. 99—550.

Photo., S. I. D., Calcutta.

No. 418-S. 99.

The cost rate of combined survey, as seen from the following table, shows a small reduction from last year, notwithstanding the amount of training of inexperienced hands :—

Year.	Cost rate per square mile.			
	Triangulation.	Traversing.	Detail survey 4-inch scale.	Combined survey.
1891-92	35·2	150·6	175·3	361·1
1892-93	33·2	138·1	160·1	331·4
1893-94	36·9	133·9	159·3	330·1
1894-95	30·1	94·0	153·5	277·6
1895-96	21·2	58·5	158·1	237·8
1896-97	...	81·8	169·8	251·6
1897-98	...	56·3	192·7	249·0

185. The cost rate for traverse work shows a very large reduction, but the cost of a square mile is not a fair comparison. The linear miles traversed are the same as last year, but the blocks being for 2-inch survey a much larger area is covered. Certain economies in the supervision which, it is thought, can be made, should keep down and reduce this item in the future.

The cost rate for detail survey shows a higher figure; this was unavoidable this year, partly on account of the sudden increase and changes in the party ; the good effects of the increase should be partly felt next season and quite the season after, when the new men will produce a full outturn. The early commencement of the rains reduced the last month's outturn by an anticipated area of about 30 square miles, but for this and the excessive amount of sickness this cost rate would have been the same as last year, notwithstanding the loss due to training the new hands.

186. The country was as difficult and as thickly covered with dense jungle, as described in previous reports. The rainfall for April and May was more than double the normal amount and commenced as early as the 12th April.

187. The health of the party was worse than usual, allowing for the large increase in numbers, probably due partly to the Pegu forests which have a bad name for fevers, and partly to the early rains; also a large number being new to the country might account for some increase in sickness. One assistant was sick most of the field season and then left on special leave. Two sub-surveyors were discharged as physically unfit and four others were invalided, one of whom died at Rangoon ; the head *tindal* and 12 *khalásis* and one interpreter died of diseases, 3 were killed by the fall of a tree in a storm, 2 were carried off by tigers, and one died of snake-bite. The tiger scare caused some delay in the work and disorganization among the post runners. Most of the surveyors were provided with guns and ammunition, which gave them some confidence.

188. No supplies, except small quantities of rice, being obtainable near the main part of the work, food depôts were established and the supply and distribution of provisions successfully done by the party.

189. During the recess all the computations and 4-inch mapping were brought up to date. Twelve 4-inch sheets were submitted for publication, and 4 more, there being a small gap in the survey, will be submitted during next field season. Eight 2-inch sheets for reduction to 1-inch have been drawn, excepting some work which will be obtained from No. 7 Party ; also 18 charts were submitted for publication and 12 General Report Volumes—

190. The programme for next season comprises. :—

(1) The triangulation and traversing of reserved forests, as may be pointed out by the Conservator, Tenasserim Circle.

(2) The detail survey on the 4-inch scale of the remainder of the South Zamayi, Kadat, Zahakawliya and Mayan reserves and small

detached reserves in Pegu and Shwegyin divisions and the East Yoma reserve in Thayetmyo. On the 2-inch scale all remaining areas unsurveyed on 4-inch scale in sheets 276 and 277. This will complete the survey of all the forest reserves of this district.

191. The party was inspected in the field by the late General Woodthorpe, R.E., Officiating Deputy Surveyor-General, in March 1898, and in recess quarters by Lieutenant-Colonel Hobday, I.S.C., Officiating Deputy Surveyor-General, in August 1898, and by General Strahan, R. E., Surveyor-General, on 30th September 1898.*

OPERATIONS OF THE FOREST SURVEY BRANCH.

192. The administrative control of this Branch was under the Inspector-General of Forests and the direct supervision of the survey operations remained, throughout the year, in the hands of Mr. W. H. Reynolds, Superintendent of Forest Surveys.

193. Survey operations were carried on in seven districts of the Central Provinces; in the Chamba State, Punjab; in two districts in Upper Burma and in the Tenasserim Circle of Lower Burma. In addition to the above the re-alignment and survey of the Nepál-Kheri boundary was taken in hand, and the survey of the realigned forest boundaries in the districts of Gonda, Bahraich and Kheri in Oudh was also taken up.

194. The field establishment comprised ten separate detachments, each of which worked under European or qualified native supervision. The total outturn of field work for the year is as follows:—

Triangulation				2,617 square miles.
Traversing				399 linear miles.
Detail Survey	Topographical	1-inch scale,	200	1,935 square miles.
	Forests	4 " "	1,499	
		16 " "	236	
Spirit levelling				672 linear miles.

195. The detail survey on the 1-inch scale was done for topographical purposes only.

196. The cost rates per square mile, by provinces, of the detail surveys are as follows:—

Province.	Detail Survey.	
	4-inch scale.	1-inch scale.
	R	R
Central Provinces	41·3	...
Punjab	50·5	19·9
Burma	90·7	...

197. For all forest areas surveyed on the 4-inch scale the usual records of forest-growth and classification of soils were prepared.

198. The topographical work was tested by running 517 miles of *partál* or check surveys through it, and the instrumental contours, which were run at fixed vertical intervals in the Central Provinces and Chamba surveys, also afforded a further check on the detail survey.

* The Officer in charge reports that Mr. W. A. Wilson conducted the traverse work in the field very satisfactorily. Mr. Ewing, always hard-working, carried out all field and recess duties with energy and ability. Messrs. Charrier and Davies returned useful work both in the field and recess.
Of the native establishment, Amjad Ali, Sharfuddin, Kyaw Nyem, Surjan Singh, Alla Ditta, Zahur Hasan, Ishaq Husain, Upendra Nath Mukerji and Mahomed Abdul Karim are deserving of special mention.

CENTRAL PROVINCES.

199. In the Central Provinces five separate detachments of the Forest Survey Branch were employed on field operations in the districts of (i) Biláspur and Ráipur, (ii) Chhindwára, (iii) Nágpur and Wardha, (iv) Seoni, and (v) Saugor. The operations were in continuation of the previous year. With the exception of the Biláspur party, the several survey detachments took the field about the middle of November and returned to recess quarters at various dates between the 4th and 25th June. The Biláspur detachment, owing to the unhealthiness of the district, was unable to commence field work before the middle of January, and was obliged to close field operations on the 12th May.

Personnel.

Mr. T. S. Marten, Extra Assistant Superintendent, 6th grade.
" J. Marten, " " " 6th grade.
" J. H. Nichol, Sub-Assistant Superintendent, 1st grade.
" C. Litchfield, " " 2nd grade.
Babu Odey Sing, Forest Surveyor.
77 Native Surveyors.

200. The following statement exhibits the areas surveyed and the expenditure and cost rate per square mile on each branch of the work:—

Forest Division.	Triangulation.		Levelling.		Topography, chiefly on 4-inch scale, including forest growth and soil record.	
	Area in square miles.	Cost rate per square mile.	Linear miles.	Cost rate.	Area in square miles.	Cost rate per square mile.
Saugor	730	7·1 (Saugor and Chhindwára)	...	...	215	54·7
Chhindwára	503		...	...	268	31·4
Biláspur	...	...	...	...	94	76·7
Nágpur, Wardha	...	...	672 (Nágpur, Wardha, Ráipur, Seoni)	6·7 (Nágpur, Wardha, Ráipur, Seoni)	306	25·6
Ráipur	...	...			...	...
Seoni	...	...			255	46·1
TOTAL	1,233	...	672	...	1,138	...

201. Of the total area topographically surveyed in detail, 902 square miles were executed on the 4-inch scale and 236 square miles on the 16-inch scale. The larger scale survey was done, as explained in last year's report, for the purpose of securing a large scale and indisputable boundary record of the Government forest reserves. The outturn of the previous season was 1,002 square miles on the 4-inch scale and 206 square miles on the 16-inch scale. The outturn of 4-inch work is somewhat less than the outturn of the previous year, which is due chiefly to the abnormally short field season of the Biláspur detachment.

202. Triangulation was extended in the Saugor and Chhindwára districts. In the former district the triangulation was done by Mr. T. S. Marten, and Mr. J. H. Nichol carried on similar work in the Chhindwára district. The only traversing that it was found necessary to run were short lengths for the purpose of connecting the existing traverse stations with trigonometrical points, and this was only done where the existing traversing passed within easy distance of the trigonometrical stations. Twenty-seven trigonometrical points were connected with the traversing. For the purpose of affording a sufficient and ample basis for adding instrumental contours to the topographical work, it was found necessary to run spirit levels through the forest blocks in the districts of Seoni, Nágpur and Wardha. A total length of 672 miles of levels was run in the reserved forests of these districts.

203. The topographical work was tested by running 343 miles of *partál* or check surveys through it and no serious errors were discovered, and the

instrumental contours, which were run at 250 feet vertical intervals, afforded a further check on the detail survey.

204. A large amount of work has been completed in the way of mapping; out of a total of 254 sheets 76 on the 4-inch scale have been published, 95 are in the press, and 83 are well advanced towards completion.

205. The average cost rate of the detail topographical surveys was R41·3 against R43·3 in the previous year.

206. Mr. W. H. Reynolds, Superintendent of Forest Surveys, visited the survey detachments in turn and inspected the field work that was in progress; he was in the Central Provinces from the 5th to the 21st March.

PUNJAB.

Personnel.

Mr. J. Marten, Extra Assistant Superintendent, 6th grade.
„ B. R. Hughes, Offg. „ „ 6th grade.
8 Native Surveyors.

207. The survey in the Chamba State of the Government leased forests on the 4-inch scale and the remainder on the 1-inch scale for topographical purposes was in continuation of the previous year's operations. Field work was carried on during the summer months, from May to September, and owing to the tracts under survey during the year being for the most part situated at high elevations and sparsely populated, it was only possible to arrange for the provisioning of a limited number of men and hence fewer surveyors than usual were employed on the 1-inch work.

208. Triangulation was extended over the greater part of the Pangi range which is an exceedingly elevated tract of country averaging from about 7,000 to 20,000 feet above sea level and drained by the Chandra Bhága river. The season's triangulation was done by Mr. Hughes assisted by a native surveyor.

209. Topographical operations on the 1-inch scale were carried on at the head waters of the main tributaries of the Ravi in the Barmaur, Chamba and Tisa ranges, and at higher elevations than usual; the 4-inch surveys were also confined to the forests in those ranges.

210. The following statement gives the areas completed during the year as well as the cost rates per square mile for each branch of the work :—

State.	Triangulation.		Detail Survey.			
			1-inch.		4-inch.	
	Area in square miles.	Cost rate.	Area in square miles.	Cost rate.	Area in square miles.	Cost rate.
Chamba	580	8·5	200	19·9	52	50·5

The total expenditure incurred in the Punjab was R12,258, of which R11,550 were on account of the survey operations in the Chamba State, whilst R708 were expended on map drawing and the publication of maps of the Bashahr State.

211. Mr. W. H. Reynolds, Superintendent of Forest Surveys, personally directed and supervised the Chamba survey, and Mr. J. Marten was with the Chamba party from June to September examining and testing the details of the topographical survey.

BURMA.

Personnel.

Mr. B. R. Hughes, Offg. Extra Assistant Superintendent, 6th grade.
Babu Bhup Sing,
„ Udey Ram,
„ Dalip Sing,
and 46 other Native Surveyors.

212. The surveys in Burma were in continuation of the previous year's operations. The field establishment was divided into three detachments and the forests surveyed were those in the divisions of—

i.—Salween-Ataran in Lower Burma.
ii.—Pyinmana } in Upper Burma.
iii.—Ruby Mines }

The survey establishment left Dehra on the 13th November and field work was commenced on various dates between the 6th and 17th December; the surveyors returned to recess quarters in June.

213. All three detachments were employed on traversing as well as detail survey on the 4-inch scale, and in the Ruby Mines division triangulation was extended as a basis for the following season's topographical work. In addition to the triangulation for the following year's work, a second connection with the Mandalay Meridional Series was effected as a check on the triangulation of the previous season. The triangulation was done by Mr. Hughes assisted by a native surveyor.

214. The following statement exhibits the areas completed, the cost of each branch of the work, as well as the average cost-rates of each class of survey :—

FOREST DIVISION.	COST OF			Total expenditure.
	Triangulation.	Traversing.	4" detail survey including mapping.	
	R	R	R	R
Salween-Ataran	...	3,587	12,376	15,963
Pyinmana	...	1,729	22,176	23,905
Ruby Mines	13,932	2,276	8,076	24,284
Total expenditure . . .	13,932	7,592	42,628	64,152
Total areas sq. mile . .	804	*211	470	...
Average cost per sq. mile .	17·3	36·0	90·7	...

* Linear miles.

215. The average cost of the 4-inch work last year was R103·1, whilst in 1895-96 it was R92 per square mile.

216. For the purpose of testing the accuracy of the 4-inch detail survey 174 miles of *partál* or check surveys were run through the topographical work.

217. The field work of the Salween-Ataran detachment was considerably disturbed throughout the season owing to the presence of Siamese dacoits in the neighbourhood of the tracts under survey; one elephant was stolen, and several unsuccessful attempts were made to carry off a second. Although the Civil authorities have used their best endeavours, the stolen elephant (which was traced into Siamese territory) has not yet been recovered.

218. The fair mapping is progressing; out of a total of 79 sheets, 49 have been published, 8 are in press, and the remaining 22 are in progress.

219. Mr. W. H. Reynolds, Superintendent of Forest Surveys, was in Burma from the 8th February to the 1st March inspecting and directing the Forest Survey Operations in that province.

NORTH-WESTERN PROVINCES AND OUDH.

220. The Government of India in letter No $\frac{567\text{-F}}{140\text{-}2}$ (Revenue and Agricultural Department), dated the 26th April 1897, having ordered the realignment and survey of the Nepál-Kheri boundary, this work was taken in hand in January and completed by the 7th of May. The realignment comprised the substitution of a line of pillars mutually visible one from the other in place of the Mohán river boundary which was constantly changing and was the source of numerous frontier boundary disputes. The demarcation which comprised a length of 64 miles of boundary defined by 81 boundary marks, was done by Mr. W. H. Reynolds, Superintendent of Forest Surveys, who was accompanied

along the whole length of the boundary by a Nepálese representative. The re-aligned Nepál-Kheri boundary will not be shown on any of the forest maps until the new boundary has been finally approved of by Government.

221. In connection with this demarcation of the Nepál boundary, 184 miles of traversing was run at a cost-rate of R6·7 per mile, and 75 square miles of detail survey was done on the 4-inch scale at a cost-rate of R39·3 per square mile.

222. In the Districts of Gonda, Bahraich and Kheri a few surveyors were employed in surveying the monoliths or new boundary marks that have recently been erected along forest boundaries; a total length of 263 miles was surveyed and the details added to the existing 4-inch maps at an average cost of R5·3 per mile.

223. Further details regarding the work carried on by the Forest Survey Branch and index maps illustrating the same, will be found in the report on the operations of the branch published under the direction of the Superintendent of Forest Surveys.*

CADASTRAL SURVEYS.

MYINGYAN, MINBU, KATHA AND LOWER CHINDWIN DISTRICTS, UPPER BURMA.

No. 3 Party.

224. Mr. E. J. Jackson took charge of this party from Mr. E. G. Little on the 3rd November.

Personnel.

Mr. E. J. Jackson, Superintendent, 1st grade, in charge from the 3rd November 1897.
Mr. E. G. Little, Extra Assistant Superintendent, 1st grade.
" J. Connor, " " 3rd "
" G. C. Swiney, " " 5th "
" M. Gastaud, " " 6th "
" W. J. Baker, Sub-Assistant Superintendent, 1st "
" W. Newland, " " 2nd "
Babu H. K. Roy, " " 3rd "
Mr. E. G. Hardinge, " " 3rd "
78 Sub-Surveyors and others.
8 Inspectors.
55 Field Surveyors (Indians).
25 " " (Burmans).

225. The programme for the season was carried out in continuation of the previous season's operations. It comprised the following:—

(*a*) The cadastral survey of 927 square miles in the Myingyan district.

(*b*) The cadastral survey of 94 square miles of scattered work in the Minbu district.

(*c*) The cadastral survey of 20 square miles of scattered work in the Katha district.

(*d*) The cadastral survey of 425 square miles in the Lower Chindwin district.

(*e*) The traverse survey of 23 square miles in the Minbu district to admit of the cadastral survey of scattered patches of cultivation being completed this season.

(*f*) The traverse survey of 764 square miles in the Lower Chindwin district, as advance work for cadastral survey.

(*g*) The traverse survey of 4 square miles in the Myingyan district.

(*h*) The traverse survey of 25 square miles of the Maymyo station.

(*i*) The triangulation of 2,345 square miles in the vicinity of Prome in Lower Burma.

(*j*) The extension of the triangulation from the Myingyan to the Lower Chindwin district.

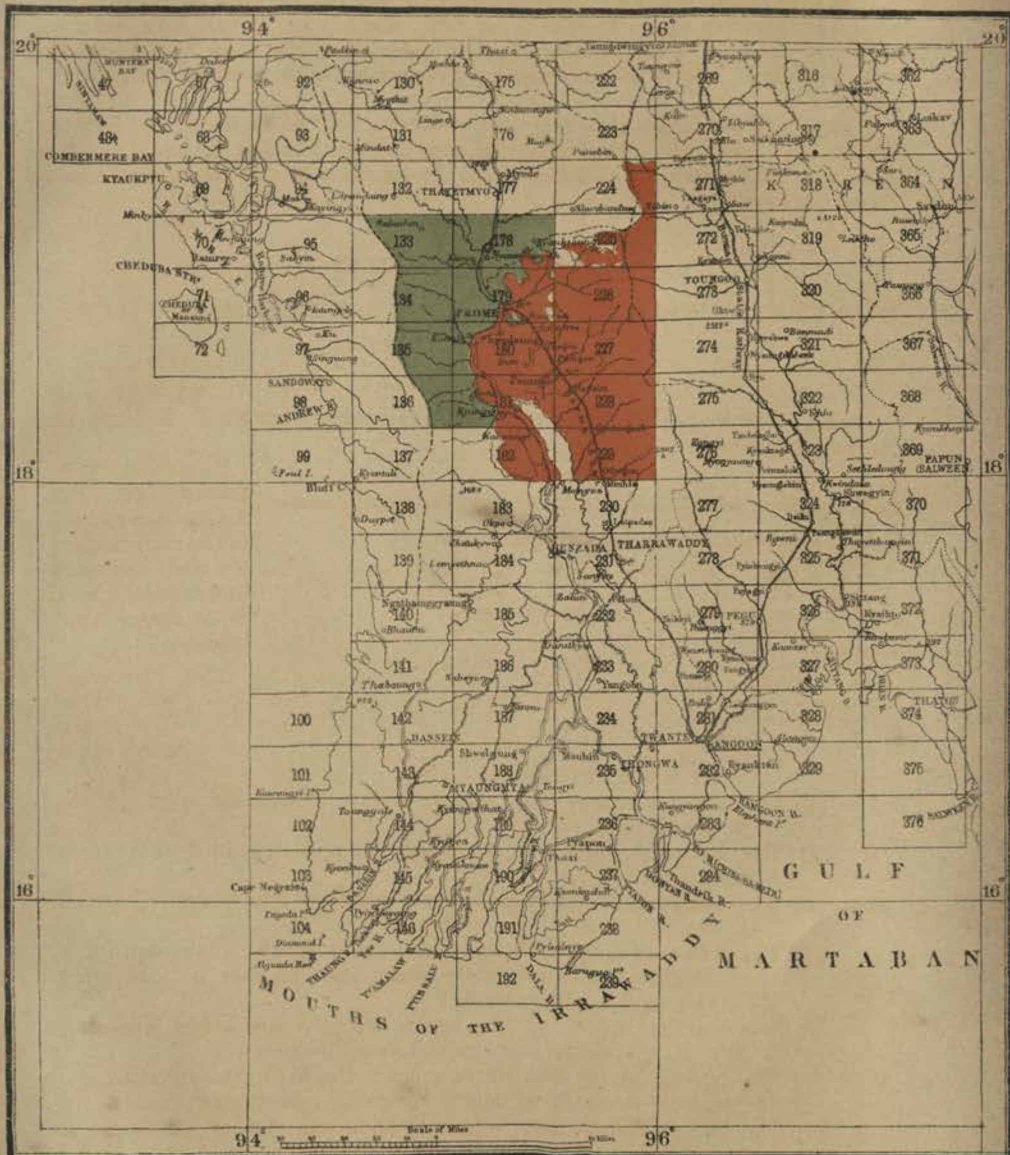
(*k*) The resetting up of 400 square miles of traverse work in the Yamèthin and Meiktila districts surveyed by local agency in season 1892-93.

* Mr. Reynolds reports that Mr. Nichol has worked most efficiently both in the field and recess, and is a promising assistant; Messrs. T. and J. Marten, B. R. Hughes, and C. Litchfield are also mentioned as having worked well and given satisfaction.

The following members of the subordinate establishment are worthy of special mention: Babus Bhoop Singh, Odey Singh, Dalip Singh and Udey Ram, as good surveyors; and Babus Badri Dutt and Bimala Charan Shome, as having done good work in the computing office.

INDEX TO THE TOPOGRAPHICAL SURVEY IN UPPER AND LOWER BURMA.

1897-98. No. 3 PARTY.



NOTE.

The numerals 180, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

The names of Cities Surveyed on large Scale are underlined thus RANGOON

REFERENCES.

Area previously Surveyed ....

" Triangulated in advance, 1897-98 ....

Photo. S. I. D., Calcutta.

Reg. No. 609, S. I. D.—Feb. 99—550

No. 421-S. 99.

BURMA SURVEY.

INDEX TO THE CADASTRAL SURVEY IN UPPER BURMA.

1897-98.

No. 3 PARTY.

REFERENCES.

Surveyed during previous Seasons on Scale

Surveyed during 1897-98 on Scale

Traversed in advance

District Boundary

Township do.

Forest do.

NOTE.

The numerals 121, &c., indicate the Standard sheets on the Scale 1 Inch = 1 Mile.

Scale of Miles

CHINDWIN

SHAN STATES

MONYWA

MYINGYAN

KYAUKPYU

AKYAB

ARAKAN HILL TRACTS

THAYETMYO

TOUNGOO

LOWER BURMA

No. 423-S. 99.

226. The detachments left Mandalay on the 9th November and assembled at Myingyan and Mônywa on the 10th and 11th dem, respectively. The *amins* and their squads had all arrived from India by the 1st December, and work was commenced soon afterwards. The establishment returned to Mandalay on the 7th and 15th July.

227. The origin of the Myingyan and Minbu districts is in Latitude 21° N., and Longitude 95° E. and the Lower Chindwin district Latitude 22° N., and Longitude 95° E. The angular work was checked by 77 observed azimuths. Two chains were used throughout, one of 100 feet in length and the other 66 feet. The traverse work was all that could be desired.

DISTRICT MYINGYAN.

228. The cadastral survey of the district was carried on in continuation of the previous season's work in 142 circles, containing 888 *kwins* situated in the townships of Natogyi, Taungtha and Myingyan. The area surveyed was 927 square miles, and the 1,241 sheets mapped on the 16-inch scale were checked by 2,805 linear miles of chain measurements of which 219 were done by European assistants, 1421 by Inspectors and 1165 by independent *partállers* after the sheets had been received in office. The average size of the field is 1·09 acres. In this district there remains 119 square miles for cadastral survey, also the scattered hills, which will be undertaken by No. 10 Party.

DISTRICT MINBU.

229. The scattered work in this district at the foot of the Arakan Yomas was carried on in continuation of the previous work and consisted of the traverse survey of 41 villages, also the cadastral survey of 163 villages along the valleys of Ngapè, Kyabin, Salin, and Sidôktaya townships. The detail survey was mapped on 208 sheets on the 16-inch scale, and comprised an area of 94 square miles. The sheets were checked by 225 linear miles of chain measurements, of which 30 miles were measured by an assistant, 96 by inspectors and 99 by independent *partállers*. Owing to the unhealthiness of the country the men suffered much from fever, two died, and at one time it was feared that a portion of the work would have to stand over for the ensuing season, as many of the men absconded; however, the district has been completed in accordance with the wishes of the local authorities.

DISTRICT KATHA.

230. This season 20 square miles of cadastral work was completed in the Ganan circle; it contained 35 villages, which were mapped on 25 sheets on the 16-inch scale. The average size of the field was 0·77 acre. An assistant *partálled* 22 miles, inspectors 19 miles, and the independent *partáller* 87 miles.

DISTRICT LOWER CHINDWIN.

231. The traverse operations in this district were carried on in continuation of the previous season's work, and comprised an area of 764 square miles. This area contained 65 circles, 393 *kwins* with 22 *pardahs*, 814 sub-traverse lines, which were checked by 42 azimuthal observations.

232. The area cadastrally surveyed in the Lower Chindwin district comprised 425 square miles, containing 49 circles and 337 *kwins* within the townships of Budalin, Mônywa and Kani. The detail survey was checked by 517 linear miles of independent *partál*, 446 miles inspectors' *partál*, and 51 linear miles by European assistants; in all 1,014 linear miles were *partálled* on 545 sheets. The average size of the fields is 1·50 acres.

233. There remain 390 villages embracing an area of 764 square miles traversed during the current season as advance work for cadastral survey; in addition to this area there remain 375 square miles for traverse and detail survey to complete the Lower Chindwin district; in all 1,139 square miles.

The outturn of cadastral work for the season is shown in the following table :—

Districts.	Cadastral Survey. 16 Inches = 1 Mile. Number of villages.	Number of fields.	Area in square miles.
Myingyan	888	539,257	926·5
Minbu	163	64,906	94·0
Katha (Ganan)	35	16,556	20·0
Lower Chindwin	337	161,811	425·0
Totals	1,423	782,530	1,465·5

234. The following traces were supplied to Calcutta and the Settlement Department :—

Districts.	Tracings for Calcutta.			Tracings for Settlement.		
	Kwins.	Fields.	Traces.	*Kwins.*	Fields.	Traces.
Myingyan	...	...	...	888	539,257	908
Katha	198	2,22,947	319	183	58,112	175
Upper Chindwin	...	...	...	508	383,863	489
Minbu	...	...	...	163	64,405	163
Shwebo	749	270,003	784	349	260,348	429
Sagaing	70	45,556	70	70	45,556	70
Yamèthin	...	...	...	58	13,099	84
Lower Chindwin	...	...	...	337	161,811	337
Magwe	4	8,472	7	...	...	...
Total	1,021	546,978	1,180	2,556	1,526,451	2,656

235. Besides the current work 27 azimuths were observed at selected trijunctions extending over an area of 400 square miles in the Yamèthin and Meiktila districts which had been surveyed by Local Agency in season 1892-93; these observations were made to admit of the revision of the traverse computations which had been based on the magnetic needle, and were consequently unfit for incorporation with our 16-inch maps, as was necessary for the completion of the 2-inch standard maps.

236. The Settlement Department divided one *kwin* as surveyed in previous season into 4 in the Magwe district, also 7 *kwins* into 14 *kwins* in the Katha district, and cut up 34 circles in the Shwebo district into 240 *kwins*, so that fresh traces and area statements, with altered field numbers had to be prepared in duplicate, one for the Settlement Officer and the other for publication.

In the Sagaing district the Settlement Department revised 70 *kwin* boundaries surveyed during season 1891-92 and 1893; here again therefore the 16-inch scale sheets had to be corrected and fresh traces prepared for publication. The area statements also had to be revised.

237. The Burma Government having asked for a survey of the station of Maymyo on a scale of 16 inches = 1 mile extending to a distance of $2\frac{1}{2}$ miles all round from the Sub-divisional Officer's court, the work was started on the 28th April and by the end of August 25 square miles of traverse work with 36 sub-traverse lines were surveyed and connected with Phanlan and Taungbyo trigonometrical stations. During the recess months an *amin* started the detail survey, but owing to the rains and sickness amongst the men the work was stopped for a time. The detail survey, however, will be taken up by No. 7 Party, and the contouring by No. 10 Party during the ensuing season.

238. According to the orders of Government conveyed in No. 2663—122-2, dated 12th November 1897, to the Revenue Secretary to the Government of Burma, this party was to be converted in 1898 into a topographical party to complete the details in Lower Burma, and the area remaining for cadastral survey in Upper Burma was to be handed over to No. 7 Party. In preparation therefore for this change an area of 2,345 square miles was triangulated in the vicinity of Prome. The area was confined between Latitudes 18° 15′ and 19° 15′, and Longitudes 94° 30′ and 95° 30′, within which 55 stations were observed at, and 43 secondary stations and 127 tertiary points fixed.

239. The triangulation was continued from the work done during season 1896-97 in the Myingyan district, based on the Great Trigonometrical bases Mozataung-Taungnyo and Taungnyo-Taungpila, and carried along the Chindwin river to test the co-ordinates brought down from Shwebo district, so that all the calculations have now been based on the same data.

240. The outturn of traverse work for the season is shown in the following table:—

DISTRICTS.	Number of villages.	Number of sub-traverses.	Number of traverse stations.	Area in square miles.
Myingyan	6	115	819	4
Minbu	41	10	763	23
Lower Chindwin	393	814	15,186	764
Maymyo station	...	36	579	25
TOTAL	440	975	17,347	816

241. In the above districts 10,400 zinc cylinders in addition to 6,947 purchased in season 1896-97, making a total of 17,347 zinc cylinders were embedded on theodolite stations as permanent traverse marks over a scattered area of 816 square miles. The cost of the cylinders purchased this season was R1,560, their carriage R1,623, and embedding them R986, in all R4,169.

242. To facilitate the preservation of the professional survey marks, 2-inch scale plots of the *kwins* surveyed were prepared in duplicate, one copy being retained by the *thugyi* and one by the Deputy Commissioner.

243. As a rule, the demarcation of the circle boundaries was good. The village or *kwin* boundaries were also demarcated in most places; where a natural feature, such as a stream or a road, did not form the boundary, or where the boundary posts had been destroyed or omitted, the boundary as indicated by the *thugyi* was surveyed.

244. No previous surveys of the districts had been made, so rough demarcation maps were furnished by the Settlement Department, but these were but little more than guides to the names and number of *kwins*.

245. The country traversed was similar to that of the previous season in the Lower Chindwin, Myingyan and Minbu districts.

246. On the whole the health of the establishment was fairly good, but two *khalásis* died in the Minbu district.

247. The Deputy Surveyor-General inspected the cadastral and traverse camps in the field in the Lower Chindwin district on the 28th and 29th March,

He also inspected the head-quarters office camp and a cadastral camp at Myingyan on the 1st and 2nd April.

The assistants were constantly inspecting the field squads and *partálling* the 16-inch scale sheets. The Executive Officer inspected the camps, inspectors and *amins*, compared *partáls* with the 16-inch scale sheets, and satisfied himself that the work was being properly looked after.*

BENGAL.

No. 4 Party.

Personnel.

Captain R. T. Crichton, I. S. C., Deputy Superintendent, 1st grade, in charge.
Mr. H. Dowman, Extra Assistant Superintendent, 1st grade.
" H. T. Hanby, Extra Assistant Superintendent, 2nd grade, attached from 1st May 1898.
" A. W. Smart, Extra Assistant Superintendent, 5th grade.
" C. S. Kraal, " " 6th grade.
" E. F. Berkeley, " " 6th grade.
" C. G. Lee, Sub-Assistant Superintendent, 1st grade, to 1st July 1898.
" T. W. Babonau (Junior), Sub-Assistant Superintendent, 1st grade, from 9th December 1897.
" C. S. Gasper, Sub-Assistant Superintendent, 1st grade.
" P. L. Causley, " " 2nd grade, from 23rd November 1897.
Babu Nilmoni Chatterjee, Sub-Assistant Superintendent, 2nd grade.
75 Supervisors and Inspectors.
12 Surveyors and Sub-Surveyors.
10 Computers
20 Estimators, Draftsmen, Writers, etc.
322 Amins (local).
323 " (imported).

248. The programme of surveys in the Province of Bengal for 1897-98 consisted of—

	Square miles.
(*a*) In Sáran—	
Traverse survey	34
Cadastral survey	536
Topographical survey	26
(*b*) In Darbhanga—	
Traverse survey	613
Cadastral survey	710
(*c*) In Noákháli—	
Cadastral survey	9·45

In addition to the above orders were received to relay the Nepál boundary touching on districts Bhágalpur and Purnea, and also the boundary of the Kachnar *mahal* in district Sháhabad.

249. The general principle of employing one native establishment for all processes of survey and record writing until the attestation stage is arrived at has been fully maintained again this year. The survey officer, besides being responsible for the accuracy of the survey, aids in the checking of the record-writing in the field, under instructions from the Settlement Department, and during recess supervises the completion of records and compilation of statistics, also under instructions from the Settlement Department.

250. The orders regarding the topographical survey of certain *diára* villages have been adhered to. The *diára* line, or line demarcating permanent from temporary cultivation in alluvial tracts, was duly laid down after the *diára* tracts had been traversed, and then the orders of the Settlement Department were taken as to which villages should be cadastrally surveyed, the remainder being taken up topographically on the 16-inch scale.

251. A difficulty arose with regard to the district boundary between Sáran and Ballia which, by Government Notification, is declared to be the deep stream of the river Gogra. In consequence of the constant changes in this river, villages which are borne on the collectorate roll of one district are now on the other side of the river, and therefore within the boundary of the adjoining district. The difficulty was eventually solved by the Settlement Officer deciding that the district boundary need not be the village boundary; the survey was therefore invariably extended to the farther bank of the river, and all villages which indisputably belonged to Sáran, but lying on the Ballia side of the river, were also surveyed. On the Gandak river the difficulties were further complicated by the fact that the river which forms the district boundary had completely altered its course since the survey of Muzaffarpur in 1893-94, consequently there

* Mr. Jackson reports highly of Messrs. Little and Connor as having managed their camps with great credit. Messrs. Gastaud, Baker, Newland and Hardinge are also mentioned as having performed their duties satisfactorily.

Of the native establishment the names of Bhagobutty Charan Chuckerbutty, Kedar Nath, Abdul Shakoor, Bhola Nath Packrasy, Mohamed Nisaraly, Bechai Khan, Tajammulaly, Pardrajoo, Rafatulla, Shafqat Rasool, Shadilall, Gaya Pershad, and Tha Aung have been brought to special notice.

BENGAL SURVEY.

1897-98. **INDEX TO THE CADASTRAL SURVEY IN DISTRICT SARAN** No 4 PARTY.

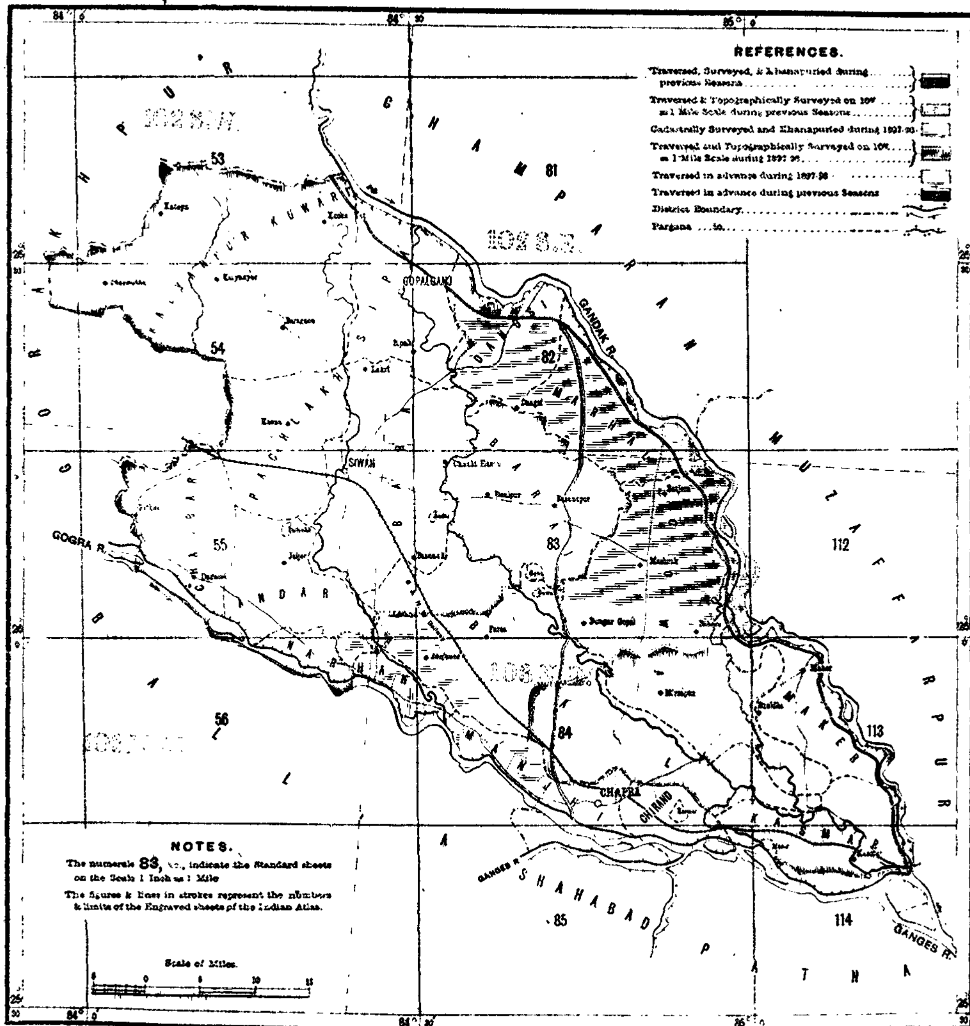


Photo. S. I. O., Calcutta

No. 528-S. 98.

was one boundary for the district as surveyed in 1893-94, and another in accordance with the present position of the river. This difficulty has been overcome by deciding that the district boundary is to be shown on our present maps as surveyed now, and that the boundary of 1893-94 is to be shown in red, with a note on the maps that the old boundary does not affect areas. This procedure, it is believed, is the best that could be adopted under the circumstances; but Captain Crichton, the Superintendent of Settlement Surveys, considers that the proper way to deal with inter-district *diára* tracts is to notify a line of villages of the adjoining district, well beyond the likely limits of river action, and to survey these in connection with the *diára* villages of the district actually under survey.

252. As a rule, the demarcation of village boundaries was very fairly done and generally followed the revenue survey *mauza* boundaries, except in the *diára* tracts, where in waste lands the inhabitants often do not know their own boundaries. All village trijunction points are marked by stones; all the intermediate traverse stations, whether actually on the boundary or at a slight distance therefrom, are marked by clay cylinders. In *diára* tracts and on disputed lands, only bamboo or wooden pegs are used to mark theodolite stations.

253. The very intricate and difficult nature of the village sites in Bihar necessitated their survey on the large scale of 64 inches=1 mile. In many instances there is no room on the margin of the 16-inch sheets for these large scale plans, and hence they have to be plotted on extra sheets: no less than 1,254 extra sheets were required for these plans of village sites. Special precautions were taken to ensure the correctness of these surveys, as an error of only two or three links is visible on such a large scale.

254. No free labour has been supplied in any of the districts in Bengal in which survey operations were in progress. Each *amin* is allowed one chainman on fixed pay, but he is provided with three coolies in addition when actually employed on surveying; these coolies received 1½ annas each per diem in Bihar.

255. The greatest difficulty was experienced both in Sáran and Darbhanga, in inducing the people to attend on the *amins* during survey, but they were eager enough to come when the record of rights was being written. This is a great improvement in the attitude of the people during the first two years of the Bihar Survey, when they were most apathetic at all stages.

256. The following civilians went through a course of survey and settlement work, *viz.*, Messrs., Marr, Emslie, Coutts, Maxwell, Kilby, in the Sáran district, and Messrs. Adie, Ramsay, Vernede, and Heycock in Darbhanga. Mr. Jeffries attended the traverse class only for a few days, when he was recalled by order of the Commissioner.

SURVEY OF THE SÁRAN DISTRICT.

257. *Traverse Survey.*—The detachment employed on traversing in North Bihar was under the charge of Mr. H. Dowman, and consisted of 12 surveyors and 10 computers. Field work commenced in Sáran on the 25th October and was practically completed by the end of November, a few small details only remaining to be completed. The whole area traversed is contained in seven river circuits, each of which was sub-divided into sub-circuits containing from seven to eight villages each; within the sub-circuits were run, when necessary, sub-traverses at an average distance of 30 chains apart. The total number of linear miles of new chaining amounts to 295 miles. Two chains of unequal lengths were as usual made use of on the river and sub-circuits; orders were issued to the surveyors to test these chains daily against two standard chains which were supplied to each man, these standards again being sent in alternately, once a week, to the head-quarters camp to be tested against the steel standard bars. One chain only was used on the village circuits. The angular work was checked by astronomical azimuths.

258. The area traversed, although supposed to be entirely *diára*, was found to comprise a considerable amount of high land. In these high portions the usual stones and cylinders were used for marking theodolite stations, but in the *diára* portions only pegs were utilised. The preliminary demarcation carried out by the inhabitants was found to be satisfactory. No opposition was experienced

by the traverse surveyors and willing assistance was as a rule afforded. The health of the establishment was excellent.

259. *Cadastral Survey and writing of Records.*—This section was under the superintendence of Mr. A. W. Smart assisted by Messrs. E. F. Berkeley, P. L. Causley, H. H. Taylor and C. S. Gasper (up to the end of November only). The native establishment consisted of 294 *amins*, 294 *moharrirs* with 33 inspectors, and the usual staff of draftsmen, estimators, etc. The section left its recess quarters at Dígha on the 28th October and commenced field work on the 2nd November. Field work was completed on the 14th April with the exception of portions of 40 villages which were under water, to finish which a small establishment kept the field until the beginning of June.

260. The programme in this district, which was drawn up by *thánas*, consisted of the completion of *thánas* Gopálganj, Mashrak, Mánjhi, Darauli and Basantpur and of an area of about 80 square miles in Chapra. The whole was completed, notwithstanding the unexpectedly large number of fields and intricate tenures.

261. The area surveyed is mapped on 996 sheets on the usual scale of 16 inches=1 mile, whilst in addition there were no less than 614 sheets on the 64-inch scale of village sites. The average size of the field is only 0·30 of an acre, the smallest yet reached in Bihar, though there is every reason to suppose that next year's work will show a still smaller size. The detail survey was checked by 1,484 linear miles run by European officers and independently, and 1,564 linear miles by inspectors, which gives an incidence of 5·49 miles of test survey to each square mile of detail. The total number of entries in the records which were checked by Europeans amounted to 6,866 and by inspectors 317,834, which give an average of 27·5 per cent on the total number of plots. These figures are exclusive of the checking done by the Assistant Settlement Officers and *kánungos*. The cost rate for detail survey was R85·89 and for the writing of records R104·29 per square mile.

262. The health of the establishment during the field season was excellent, but immediately after returning to recess quarters, there were nine cases of cholera, of which two proved fatal.

263. *Topographical Survey.*—The areas forming the *diára* tracts along the banks of the Gandak and Gogra rivers were surveyed topographically on the 16-inch scale. The survey is mapped on 46 sheets. The village sites were surveyed in blocks in their true positions on the plans. All topographical items of importance and suitable for reduction for the standard maps were accurately surveyed. The work has been checked by 44 linear miles of chaining run by Europeans independently and by 31 linear miles by inspectors. The cost rate is R26·36 per square mile.

264. The areas of work completed are given in the following table :—

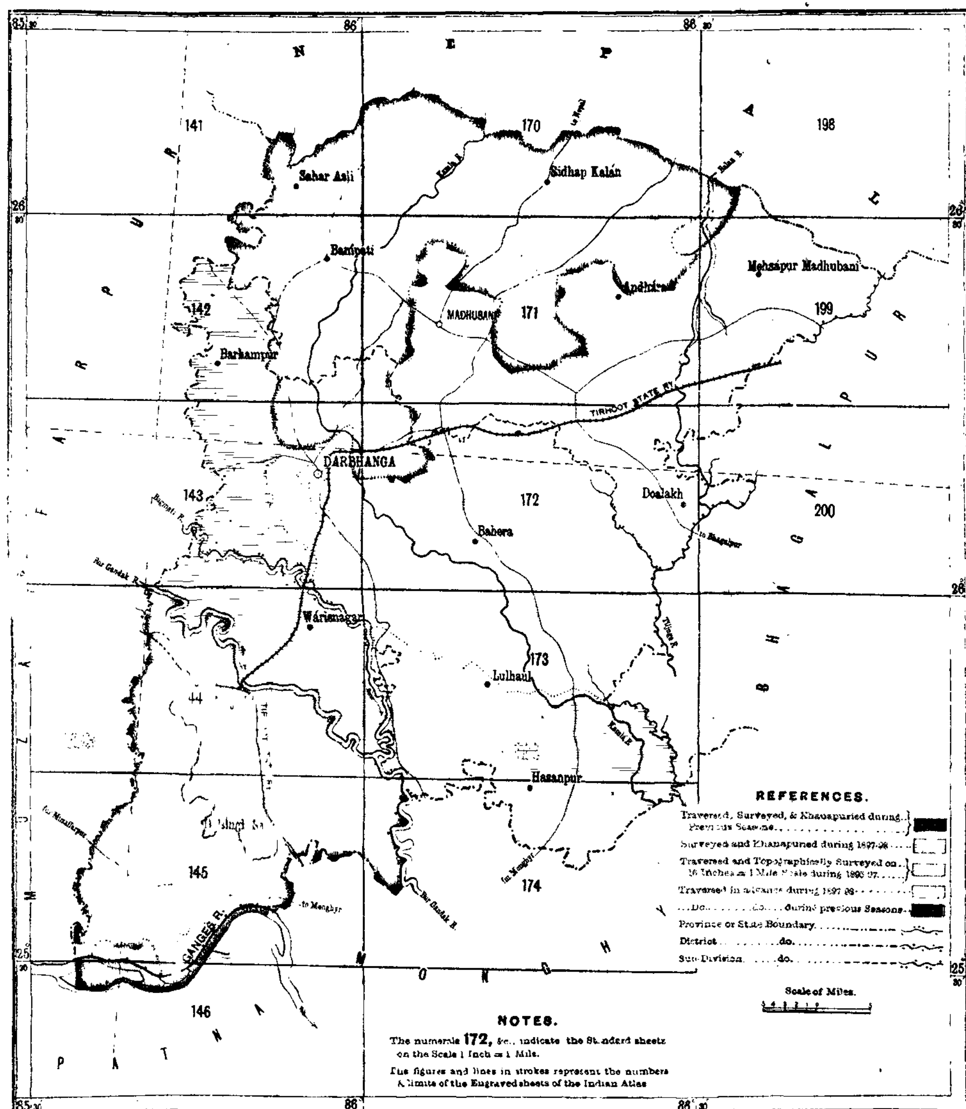
District.	Traverse survey.		Cadastral survey, 16 inches=1 mile and record writing.			Topographical survey 16 inches=1 mile.
	Number of stations.	Area in square miles.	Number of villages.	Number of fields.	Area in square miles.	Area in square miles.
Sáran .	1,173	36·7	877	1,180,871	555·3	27·4 includes 14·2 square miles in Ballia.

Survey of the Darbhanga District.

265. *Traverse Survey.*—The field work in this district commenced about the beginning of December when the traverse operations in Sáran had been completed, and was completed by the 20th April, when the traverse section retired to its recess quarters at Mussooree; office was opened on the 3rd May. The area completed is comprised in three main circuits, containing 40 sub-circuits; each sub-circuit contained on an average 22 villages and covered an area of 15 square miles. Within the village circuits there were 1,056 sub-traverses, at an average

BENGAL SURVEY.

1897-98. INDEX TO THE CADASTRAL SURVEY IN DISTRICT DARBHANGA. No. 4 PARTY.



Reg. No. 317, S. I. D.—Dec. 98—1,050.

Photo. S. I. O., Calcutta.

No. 527-S. 98.

BENGAL SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTRICT MUZAFFARPUR.

1897-98. No. 4 PARTY.

NOTES.

The numerals 112, &c., indicate the Standard sheets on the Scale of 1 Inch = 1 Mile.

The figures and lines in strokes represent the numbers & limits of the Engraved sheets of the Indian Atlas.

Scale of Miles

10 5 0 10

NEPAL

CHAMPARAN

SARAN

PATNA

DARBHANGA

109 110 111 112 113 114 115 82 83 140 141 142 143 144 145 146

Malai, Akhta, Babra (Zila Turki), Mahila, Babra, Shewhar, Babra (Zila Turki), Madhkaul, Sonbarsa, Tariani, Morwah Kalan, Tilakchaund, Tirsut, Banaul, Dilawarpur, Kanhauli, Naranga, Mahind, Nizamuddinpur, Parihárpur, Kumra, Laduari, Sitamarhi, Bahadurpur, Basotra, Rasulpur, Nanpur, Sahebganj, Gadesar, Jasauli, Bisara (Tappa Bhatsalla), Kanti, Morwah Khurd, Karupur, Garh Chawand, Katra, MUZAFFARPUR, Barail, Paru, Bisara (Chakla Naie), Bisara (Chakla Garjaul), Subkarpur, Kasma, Ratti, Shampur, Padmaul, Bhurwari, Balgaon, Lalganj, Garjaul, Bisara (Chakla Garjaul), Saraisa, Hajipur, Jafarpatti, Naurangpur, Manhara, PATNA, Raghupur, Rupas

GUNDUK R.

TIRHOOT STATE RAILWAY

GANGES R.

E.I. STATE RAILWAY

85° 0′ 85° 30′ 86° 0′ 27° 26° 30′ 26° 0′ 25° 30′

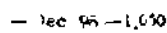
REFERENCES.

Cadastral Survey previously done with records

.... Do........ with records in 1897-98

Traversed & Topographically Surveyed, 1897-98

Traversed in advance, 1897-98



Province or State Boundary

District do

Pargana do

Photo. & ... Calcutta

Reg. No. 2... — Dec. 98 — 1,050

No. 529-S. 98.

distance apart of 30 chains. The aggregate number of linear miles of new chaining amounts to 2,617. The same arrangements for ensuring accurate chaining were made here as in Sáran. Of the 14,855 new theodolite stations, 1,538 trijunctions have been marked by stones, 12,612 stations on the village and sub-traverse circuits by clay cylinders, and the remaining 705 stations, which were on disputed lines, by pegs. Astronomical azimuths were taken at 127 stations on the main and sub-circuits. Four stations of the North Párasnáth Meridional series have been connected with. The demarcation was found to be satisfactory, and there was no difficulty in dealing with the inhabitants, who as a rule, freely accorded all necessary assistance. The health of the establishment was excellent.

266. *Cadastral Survey and writing of Records.*—The cadastral section was under Mr. C. S. Kraal assisted by Messrs. C. G. Lee, T. W. Babonau and Babu Nilmoni Chatterji. The native establishment consisted of 39 inspectors, 350 *amins*, 350 *moharrirs* with the usual staff of draftsmen and estimators. The section left for the field on the 28th October, and returned on the completion of its programme on the 26th April. The programme, which was by *thánas*, comprised the *thánas* of Roserha and Warisnagar, and an area of about 187 square miles in *thána* Darbhanga.

267. The area surveyed is mapped on 1,298 sheets on the 16-inch scale, and on 640 additional sheets of village sites on the 64-inch scale. The average size of the field is 0·42 of an acre. The detail survey was checked by 1,259 linear miles of chaining run by survey officers and independently, and by 1,918 miles by inspectors, giving an incidence of 4·34 linear miles of test survey to each square mile of detail. The total number of entries in the records checked by survey officers was 10,105, and by inspectors 276,103, giving an average of 26 per cent on the total number of plots. The demarcation by the inhabitants was fairly good and the boundaries agree well with the old revenue survey *mauzas*. The general health of the establishment during both the field and recess seasons was fairly good. The attitude of the villagers towards the survey operations was exactly the same as in Sáran, *i.e.*, indifference during the survey stage, and great keenness when the records were being written. The cost rate of detail survey is R74·86, and for writing records R78·32 per square mile.

The areas completed are given in the following table:—

District.	Traverse Survey.		Cadastral Survey, 16 inches = 1 mile, and Record-writing.		
	Number of stations.	Area in square miles.	Number of villages.	Number of fields.	Area in square miles.
Darbhanga . .	14,855	597·7	965	1,100,808	732·54

Survey of the Muzaffarpur District.

268. *Traverse Survey.*—During the survey of *thána* Mashrak, in Sáran, it was ascertained that an adjoining tract of about 5 square miles had been omitted from the district of Muzaffarpur in 1893-94. This omission was due to a change in the course of the river Gandak, which had cut into the Muzaffarpur district, thus temporarily placing this area in the Sáran district. The amount of traversing executed, including the necessary overlap to form a proper connection with the old work, has been included in the statement of areas completed in the Sáran district.

269. *Cadastral Survey and writing of Records.*—Of the above area it was decided to cadastrally survey only about 1½ square miles; the survey is contained in 5 sheets on the 16-inch scale. The average size of the fields is 3·72 acres. It was subjected to the usual amount of testing.

270. *Topographical Survey.*—The balance of nearly 4 square miles was surveyed topographically; it was completed and tested on exactly the same lines as the topographical work in the Sáran district.

SURVEY OF THE NOÁKHÁLI DISTRICT.

271. *Cadastral Survey and writing of Records.*—The survey in this district comprised the *chars* Magdhora and Magdhora Mudafat Amanat Ali, both otthe east of Sandip Island; the area amounted to approximately only 10 square miles. The traversing and the topographical survey of the neighbouring portions had been completed in 1896-97, but this small area had to be omitted owing to the exceptional difficulties alluded to in last year's report. The area to be surveyed being small, and there being no detachment working in Eastern Bengal, it was decided that no assistant should be deputed, but that Captain Crichton should himself control the establishment directly through the Settlement Officer. The area surveyed was 10·28 square miles, comprised on 9 sheets on the 16-inch scale. The accuracy of the survey was checked by 53 linear miles of test survey, whilst 22 per cent of the entries in the field records were checked. Difficulties in obtaining provisions and good drinking water were experienced, but these are unavoidable in such situations.

272. In addition to the above more important works several smaller ones were completed, such as the completion of the traverse computations and of the records and statistics of eight villages of the Majnamutha estate in Midnapore district the finishing up of the traverse records of the Tikári Wards Estate, in Gaya, the survey of which was completed by No. 2 Party in 1894-95; the final examination of the traverse records of the Narhan Ward's Estates in district Monghyr; and the survey on the 64-inch scale of the town of Samastipur in Darbhanga, the *raiyati* lands of which had been surveyed in 1895-97; the relaying of the boundary marks of the Kachnar *mahal* lying within the Government estate of Bánskáti in district Sháhabad, which, however was not successful owing to the surveyor having misunderstood his instructions; and the survey of 3·3 square miles of *mauza* Gobindpur Tera Rasia in the Hájipur *diára* tracts in district Muzaffarpur.

THE RELAYING OF MARKS ON THE NEPÁL FRONTIER TOUCHING ON DISTRICTS BHÁGALPUR AND PURNEA.

273. Acting under instructions from the Government of Bengal, the Superintendent of Settlement Surveys deputed Mr. E. F. Berkeley to relay the boundary marks in the places where they had been swept away during the inundation. By the middle of November the river Kosi had fallen sufficiently to allow the work to be commenced, but it was not until the 3rd December that a Nepálese official, the Lieutenant of Rangli, arrived; then Mr. Berkeley, accompanied by the Deputy Magistrate of Araria and the Lieutenant of Rangli, marched along the boundary erecting new posts where required. The ditch which had originally been dug along the boundary was so much out of repair as to be in parts not traceable; Captain Crichton accordingly suggested to the Commissioner that, as the boundary is marked out by pillars, except where it follows natural features such as streams, also as no reference is made to it on the old map, the ditch should be ignored; this was agreed to. On the 14th December the work along the Bhágalpur and Nepál boundary was completed and the Lieutenant of Rangli took his departure. Again considerable delay was caused by the non-attendance of an official from the Nepál side, and as Mr. Berkeley was urgently wanted for his proper work in Bihar, he was recalled and Mr. C. S. Gasper took his place. After much delay the same procedure was carried out along the boundary bordering on the Purnea district. Owing to dilatoriness on the part of the Nepál Darbár in replying to suggestions made to them with reference to the position of certain pillars it was impossible to complete the whole line before the commencement of the rains. In order to save the expense of sending a survey officer almost every season to relay this line of boundary whenever it, or portions of it, are washed away by the Kosi river, the Superintendent, Settlement Surveys, suggested to the Commissioner that points be permanently fixed by erecting reference pillars on the high banks on each side, so that the intersection of lines drawn between these reference pillars should indicate the site of the three points at which the boundary takes a new direction. The Commissioner approved of this, but the Nepálese official objected to the erection of any pillar on the Nepálese territory without reference to the Darbár.

BENGAL SURVEY.

INDEX TO THE CADASTRAL & TOPOGRAPHICAL SURVEYS IN DIST. NOAKHALI.

1897-98. DETACHMENT.

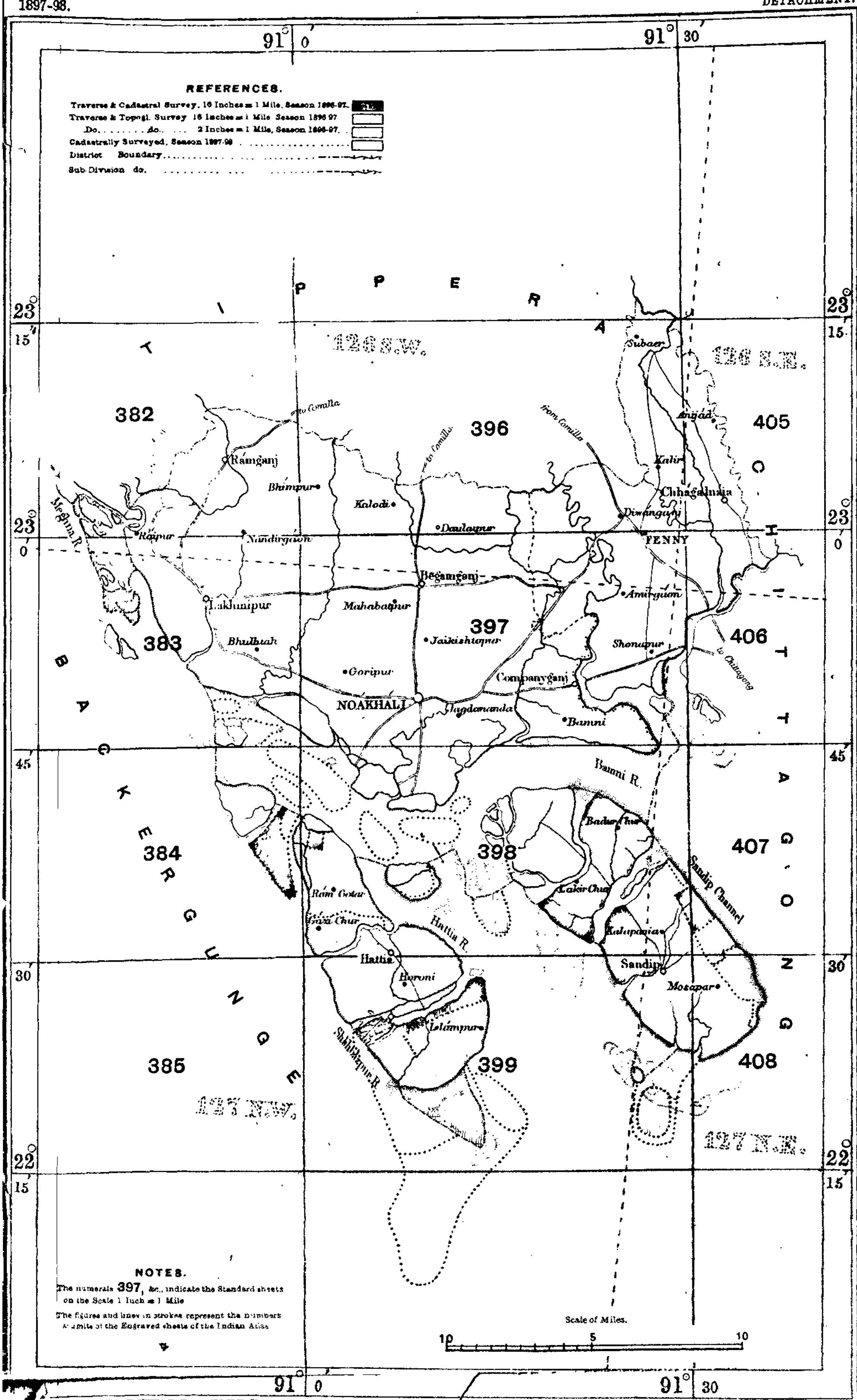


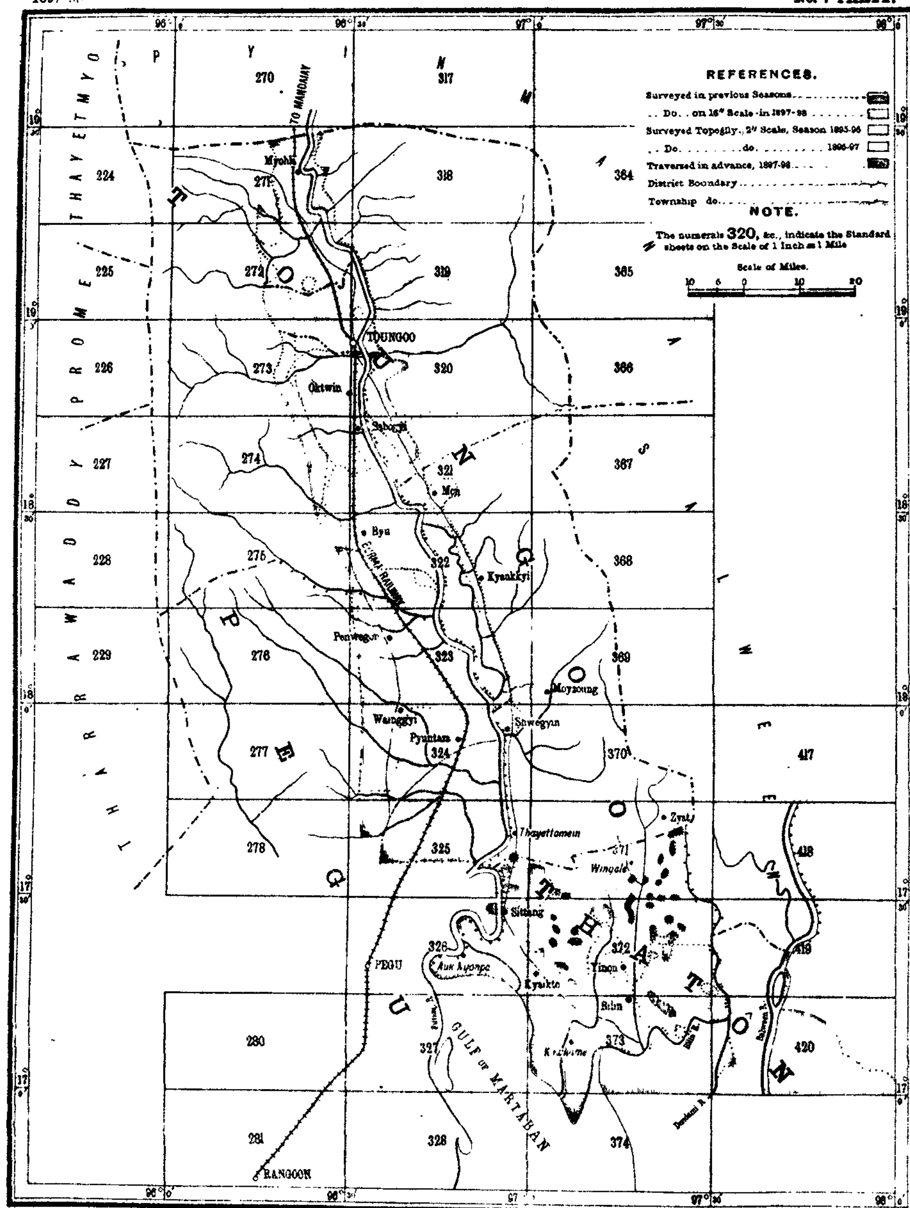
Photo. S. I. O., Calcutta.

No. 530-S. 98.

BURMA SURVEY.

INDEX TO THE CADASTRAL SURVEY IN DISTS. THATON, PEGU, & TOUNGOO.

1897-98 No. 7 PARTY.



Reg. No 391, S. I. D.—Jan. 99—530 Photo. S. I. O., Calcutta

Programme for season 1898-99.

274. The following statement shows the areas remaining to complete the survey of North Bihar :—

DISTRICT.	Traverse survey.	Cadastral survey and records.	*Diára* Topographical survey.
	Sq. m.	Sq. m.	Sq. m.
Sáran	143	535	87
Darbhanga	521	1,900	...
TOTAL	664	2,435	87

The existing orders of Government of India, *vide* No. $\frac{1868}{40-5}$, dated 3rd June 1896, are that this survey is to be completed by the 30th September 1900; it has therefore been arranged to complete the whole of the traverse and *diára* survey and 1,215 square miles of cadastral survey this next season, leaving the balance of 1,220 square miles for season 1899-1900. The Bengal Government has also issued orders for several other survey operations to be undertaken; the whole programme is exhibited in the following table :—*

DISTRICT.	Traverse survey.	Cadastral survey and records.	TOPOGRAPHICAL SURVEY.		
			16" scale.	4" scale.	2" scale.
	Sq. m.	Sq. m.	Sq. m.	Sq. m.	Sq. m.
Sáran	143	535	87	...	...
Darbhanga	521	680	...	...	...
Backergunge	150	...	...	...	...
Champáran	90	...	...	...	90
Burdwan	88	...	...	88	...
Bhágalpur	33	33	...	...	...
Darbhanga City	7	7	...	...	...
Roserha	2	2	...	...	...
Nepál Boundary	...	...	...	...	...
Sháhabad (Kachnar Mahal)	...	...	...	...	...
TOTAL	1,034	1,357	87	88	90

TOUNGOO DISTRICT, LOWER BURMA.

No. 7 PARTY.

275. Up till 15th December 1897 Mr. W. C. Price held temporary charge of this party, when Mr. B. G. Gilbert-Cooper returned from privilege leave and resumed charge. On the 12th September 1898 Mr. Gilbert-Cooper was transferred to the charge of Nos. 2 and 8 Parties and Mr. Price was again placed in temporary charge until relieved by Mr. T. E. M. Claudius on the 22nd September 1898.

Personnel.

Mr. B. G. Gilbert-Cooper, Deputy Superintendent, 1st grade, in charge from 16th December 1897 up to 11th September 1898.
" T. E. M. Claudius, Extra Assistant Superintendent, 1st grade, in charge from 22nd September 1898.
" W. C. Price, Extra Assistant Superintendent, 2nd grade, in charge up to 15th December 1897, and again from 12th to 21st September 1898.
" G. W. Jarbo, Extra Assistant Superintendent, 4th grade.
" J. S. Swiney, " " 5th "
" M. Gastaud, " " 6th " up to 14th November 1897.
" T. W. Babonau, Sub-Assistant Superintendent 1st grade, up to 8th December 1897.
Babu Amar Singh, " " 2nd grade, up to 31st May 1898.
" Abinash Chunder Bose, " " 2nd grade.
22 Sub-Surveyors, etc., and 165 temporary Field Surveyors, Inspectors, etc.

* Captain Crichton reports that Messrs. H. Dowman, A W. Smart and C.S. Kraal in charge of traverse and cadastral sections have managed their camps very well; Mr. H. T. Hanby, who was lent from Nos. 2 and 8 Parties for the recess season, has rendered valuable service and that the Assistants, Messrs. E. F. Berkeley, T. W. Babonau (Jr.), C. G. Lee, C. S. Gasper, Nilmoni Chatterji and P. L. Causley, have given satisfaction. In the temporary establishment Messrs. H. H. Taylor, A. E. LeFranc, and W. Babonau are well spoken of.

276. The party was divided into three sections as follows: section No. 1 (cadastral) under Mr. J. S. Swiney, operated in the Shwegyin and Kyaukkyi townships of the Toungoo district, commencing field work on 16th December 1897 and closing on 31st May 1898. Section No. 2 (cadastral) under Mr. Price, commenced field work on 16th December 1897, in the Zeyawadi township of district Toungoo, and closed on 31st May 1898. Section No. 3 (traverse) under Mr. Jarbo, began work on 2nd November 1897, and closed on 28th May 1898, operating in the Shwegyin, Bônmadi, Zeyawadi, Tantabin, Myoma, and Thagaya townships of the Toungoo district.

277. The programme of the field season consisted of:—

(*a*) The completion of the traversing in the Toungoo district.

(*b*) Detail Survey, Toungoo district, 800 square miles on 16-inch scale in circles Kyaungbya, Sethlèdaung, Kyaukkyi, Kyaukhmaw, Môn, Bônmadi, Tantabin, Minbôn, Zeyawadi, Tetpyauk and Kaungyan.

278. The demarcation was well done this year and there were no complaints of delay to the work in consequence of the demarcation not being ready. The Settlement Officer complained of the large size of some of the *kwins* in the Yegyi and Tantabin circles, which had to be sub-divided, and the Demarcation Officer received instructions to be careful to make them smaller in future.

279. The following statement shows the season's outturn, exclusive of the survey of the Sadar Bázár, Rangoon:—

Localities.	Traverse Survey.		Cadastral Survey 16 Inches=1 Mile.		
	Number of *kwins*.	Area in square miles.	Number of *kwins*.	Number of fields.	Area in square miles.
Toungoo	424	893	376	423,365	770

280. Of the total area traversed embracing 424 *kwins*, 67½ square miles consist of forest and fuel reserves falling within the area to be cadastrally surveyed, the traverse data of which will be made over to No. 20 Party, which will take up the details topographically in due course; thus leaving 825½ square miles of advance traverse ready for cadastral detail survey. The theodolite was set up at 19,574 stations, and 2,734 linear miles of double chaining was done. This work was checked by 135 astronomical observations for azimuth. Owing to their great portability clay cylinders were used throughout for marking the stations.

281. The detail operations on the 16-inch scale in the Toungoo district were checked by 2,005 linear miles of chain measurements, of which 822 were done, partly independently after the sheets had been received in office and partly by European assistants. The proportion of cultivation to jungle is as 1 to 2, and the average size of the field is 0·44 of an acre, calculated on the cultivated area only.

282. In addition to the above new survey 60 villages of district Pegu were revised owing to representations of the Settlement Officer that large extensions of cultivation and alterations in field limits had taken place, particularly in the areas more recently brought under cultivation, in some instances necessitating an entire resurvey of a village.

283. The total expenditure for the year, inclusive of Rangoon Town Survey charges, was R1,83,352, including a charge of 4 per cent for instruments. The cost rate of the traverse operations in district Toungoo was R57-10-1 per square mile, and the cost rate of detail 16-inch survey in the same district, was R142-15-0 per square mile. The cost rate of revision, or rather extension survey in district Pegu, was R249-5-11 per square mile, being nearly double that of original detail survey, on account of the very scattered nature of the work.

284. The country under traverse and cadastral survey was very unhealthy and retarded the work considerably.

285. The season's detail 16-inch work in district Toungoo is mapped on 1,006 sheets. The whole of the sheets will be completed and ready for publication by the end of the recess season. The tracings and area statements of the 376 villages cadastrally surveyed in district Toungoo are nearing completion, and will be ready for despatch to the Settlement Officer by the commencement of the field season.

286. The 2-inch mapping of standard sheets Nos. 372 S.W., N.E., S.E., 373 S.W., N.E , S.E., 326 S.E., 325 N.W., N.E., 324 N.W., S.W., N.E., S.E., 323 N.W., S.W., and 374 N.E., S.E., has been completed. The hill drawing remaining over from last year was completed this season by Mr. M. Gastaud, who was attached to the party for the work. The following are remaining to complete, *viz.*, 323 N.E., S.E., 322 N.W., S.W., N.E., S.E., 321 N.W., S.W., S.E.

287. Dysentery and fever were very prevalent amongst the *khalásis* working in the Toungoo district, nearly one-fifth of the menial establishment being incapacitated for work during the field season from these causes, 16 men died from fever and dysentery, 4 from cholera and 1 from small-pox; 14 men absconded, and 20 men had to be sent home, being too ill to continue at work. The health of the assistants was good throughout.

288. The number of Burmans and Karens employed this season in the detail survey was 26. They all worked well and gave satisfaction. The two Burman inspectors know their work thoroughly and gave complete satisfaction. The average monthly earnings of the Burmans and Karens employed is R37-13-9, and those of the Hindustáni surveyors for the same period R41-4-3.

289. The programme of the party for the coming field season consists of:—

	Square miles.
Cadastral survey, Toungoo	700
Revision survey, Toungoo	55
Cadastral survey, Myingyan	119
TOTAL .	874

The above figures represent the areas remaining for survey to complete districts Toungoo and Myingyan. This latter district formed part of the programme to be completed by No. 3; this party is however to be made into a topographical party and its programme in Upper Burma will be handed over to No. 7.

290. Thanks are due to the Deputy Commissioner of Toungoo, Mr. D. Wilson, I.C.S., and to his successor, Captain Pritchard, I.S.C., for the cordial assistance rendered by them to the Survey Department during the past year.

Rangoon Town Survey.

291. The remaining maps and records of the Rangoon town survey were completed by the end of November 1897 within the time allotted, and the maps were shortly after sent to Calcutta for publication. The cost of completing these sheets, etc., was R5,007. The total cost of the Rangoon town survey from start to finish amounted to R1,08,104, exclusive of the printing and publication of the maps, for which a separate estimate was made. There was, therefore, a saving of R5,926 on the sanctioned estimate.

Survey of Rangoon, Sadar Bázár.

292. The Rangoon Sadar Bázár was surveyed at the request of the cantonment authorities on the scale of 50 feet to the inch, its cost amounted to R1,428 and R28 for demarcation.

293. The party was inspected in the field in February 1898 by the late Major-General Woodthorpe, who was then officiating as Deputy Surveyor-General; he expressed his satisfaction with all he saw. The party was again inspected in recess on 30th and 31st August, and on 1st September 1898 by Lieutenant-Colonel Hobday, who had succeeded Major-General Woodthorpe, when the arrangements for the approaching transfer of the party to Upper Burma, to take the place of No. 3 Party, were discussed.*

* The officer in charge reports that Messrs, W. C. Price, G. W. Jarbo, and J. S. Swiney have managed their sections in a very satisfactory and able manner; and that the other assistants have also given every satisfaction. Of the Native establishment, the following are deserving of special mention:— Mr. C. Abrew, Moung Hpo Kah, Shashi Bhusan Ghosal, Durga Prosona Shore, and Mahbub Ali.

NORTH-WESTERN PROVINCES AND OUDH.

294. The records of district Meerut and the Lalitpur sub-division of Jhánsi, which had not been finished in October 1897, were completed by December, and made over to the Settlement Officers. The original field maps were despatched to the drawing section of Nos. 2 and 8 Parties, Mussooree.

The survey and records of Sháhjahánpur were completed, the maps sent to drawing office, and the records made over to the Settlement Officer.

The field survey and record writing of four *parganas*, Chándpur, Báshta, Burhpur and Nagína in district Bijnor were completed; the records prepared in office, are nearing completion, and will be made over to the Settlement Officer in December.

The field survey and record writing of the Bahraich district have been completed; the office records will probably be ready by December.

A small portion of the Nepál and Bahraich boundary re-demarcated by officials deputed for this duty was surveyed under the Survey Officer's orders and a map made over to the Deputy Commissioner. Certain points were still pending approval.

Survey and record writing were continued in Bareilly and Kheri and commenced in Gonda. In the last two districts on the two years' system.

295. The total area of the districts and tracts of which survey and record writing has been completed since 1894 (including the small tracts of Kakarbái and Gursarái in Jhánsi and the alluvial *mahals* in Sítápur) covers 7,165 square miles, and the average cost per square mile, taken all round, R49-5-7, or, with superintendence and all other charges, including cost of instruments, R58-13-7 per square mile. Of the above area 1,085 square miles were surveyed during the past season (1897-98).

In the districts not yet completed an area of 2,355 square miles was surveyed, and *khasras* written of 2,080 square miles at an average cost of R49-12-0 per square mile, or, with superintendence and all other contingencies, R59-4-0 per square mile. A portion of the enhanced cost is due to the completion of records of previous years where this had fallen into arrears, and partly that on the two years' system where the operations are extended over a much larger area, assistant surveyors, and a greater number of inspectors and *mirdahas* (or chainmen) are required.

296. In the several districts under survey 1,533 *patwáris* were attached to survey training classes; of these, 1,295 qualified, and surveyed villages, 164 sent heirs as substitutes, who were provided chiefly from the *umedwár kanungos* sent from other districts for training, of whom there were 222 in all, most of whom qualified.

Twenty-five *kanungos* and 7 *naib* registrar *kanungos* joined the surveys; 4 of the former were transferred before passing.

Thirteen students of the Agricultural School, Cawnpore, were trained in Bareilly; only one failed.

Twenty junior civilians were instructed in the methods of surveying villages cadastrally, and were attached subsequently to the several survey parties for two months

297. The survey of cultivated lands in the Naini Tal district on the scale of 64 inches to the mile and the preparation of 4-inch index maps was extended, and 64 square miles were completed.

It is believed there are still 20 square miles of cultivation to survey, the total cultivation according to the previous district records, being a little over 50 square miles. The cost for survey and *khasra* writing has been R360-11-0 per square mile, or, if cost of preliminary test surveys and of instruments is added, the total is R416-11-0 per square mile. That of the Garhwál survey on the 32-inch scale and based on the traverse survey was about R800 per square mile.

The survey is being made entirely by Garhwáli *amins* trained on the Garhwál survey as there are no *patwáris* in the ordinary sense of the term.

298. The accuracy of the old Settlement village maps of Cawnpore, Fatehpur and Allahabad districts were checked by numerous lines run across them by the Superintendent and Mr. Johnson. Those of the first two were fairly accurate, those of Allahabad less so, especially on the outskirts of large villages.

N. W. P. & OUDH SURVEY.

INDEX TO THE LAND RECORDS SURVEY IN N. W. P. & OUDH.

1897-98.

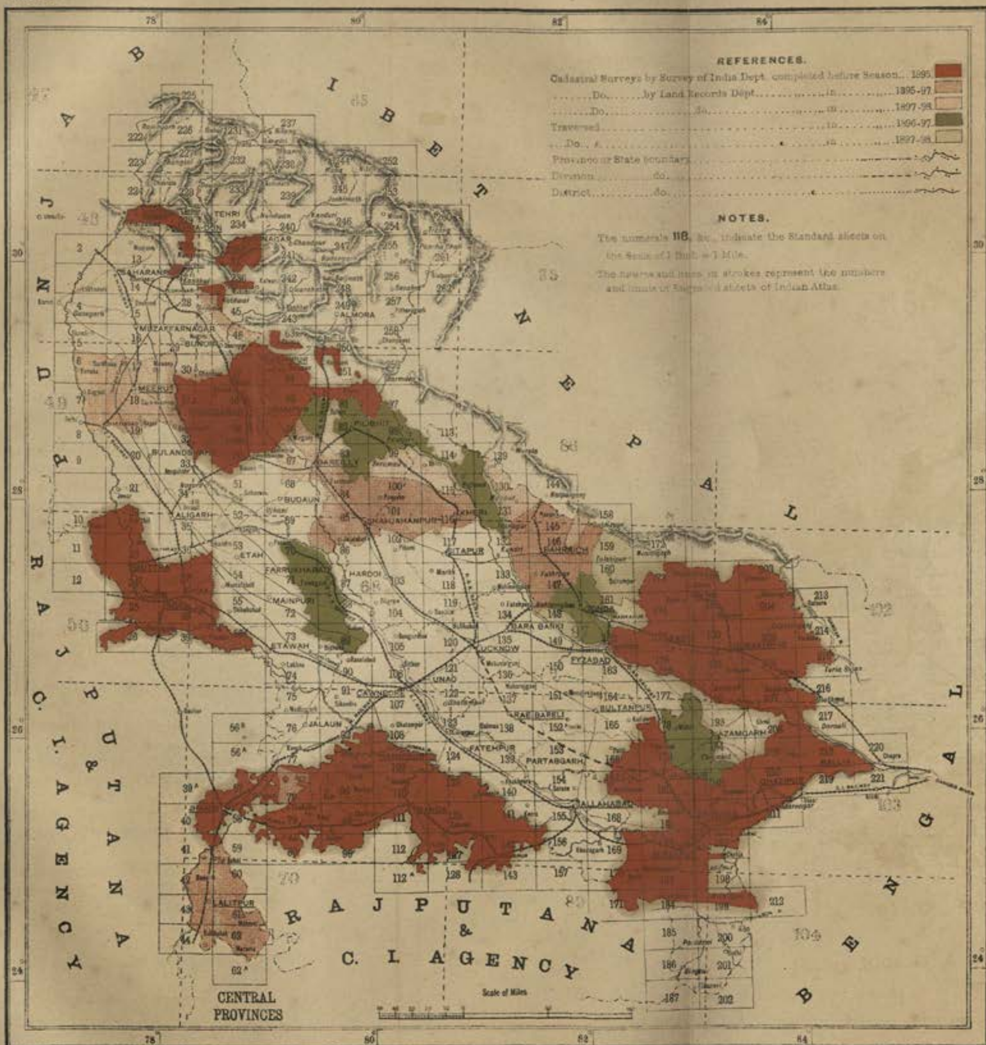
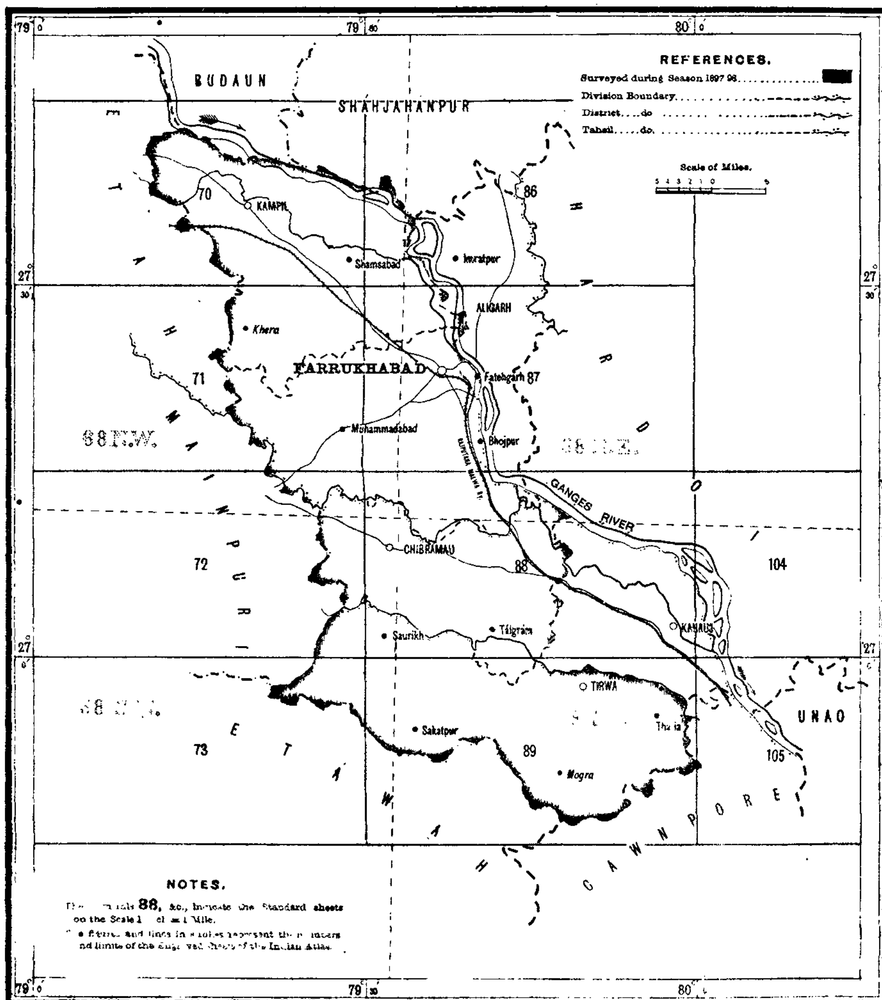


Photo. S. I. O., Calcutta.

No. 462-S. 99.

N. W. PROVINCES SURVEY.

1897-98. **INDEX TO THE TRAVERSE SURVEY IN DISTRICT FARRUKHABAD.** Nos. 2 & 8 PARTIES.



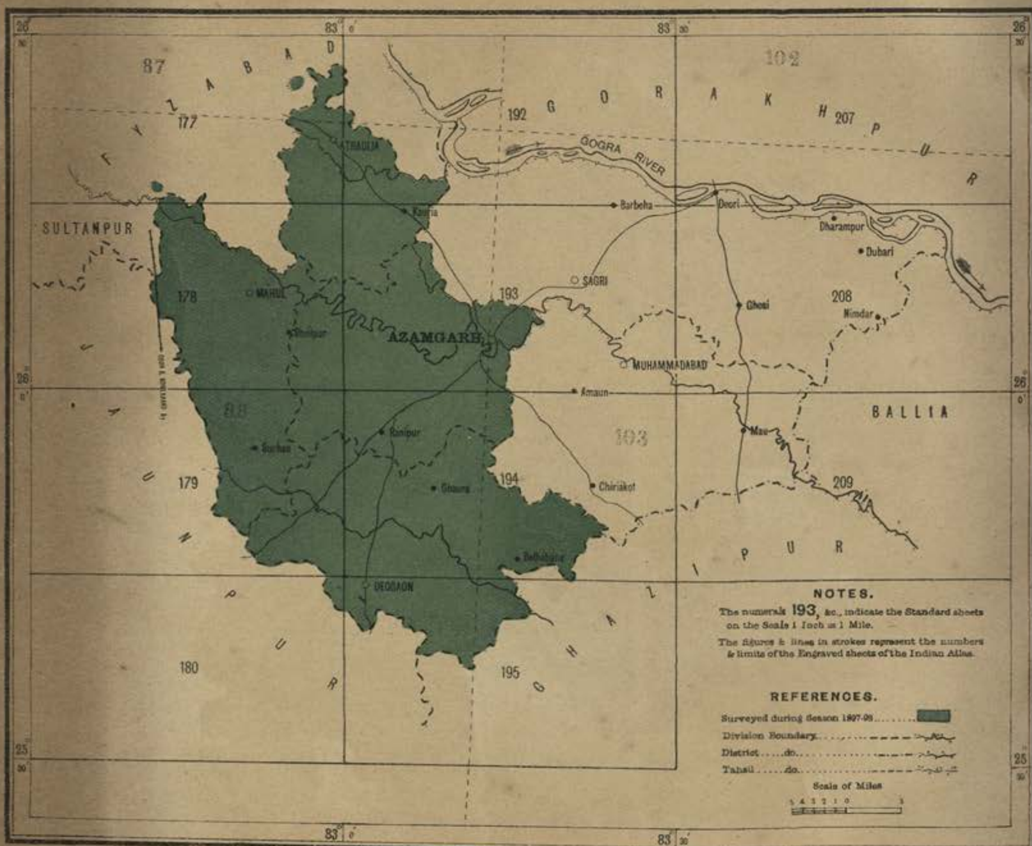
Reg. No. 381, S. I. D.—Dec. 98—500.

Photo. S. I. O., Calcutta.

No. 533-S. 98.

N. W. PROVINCES.

1897-98. **INDEX TO THE TRAVERSE SURVEY IN DISTRICT AZAMGARH.** Nos. 2 & 3 PARTIES.



No. 520-S. 98.

N. W. P. & OUDE SURVEY.

1897-98. **INDEX TO THE TRAVERSE SURVEY IN DISTRICT PILIBHIT.** Nos. 2 & 3 PARTIES.



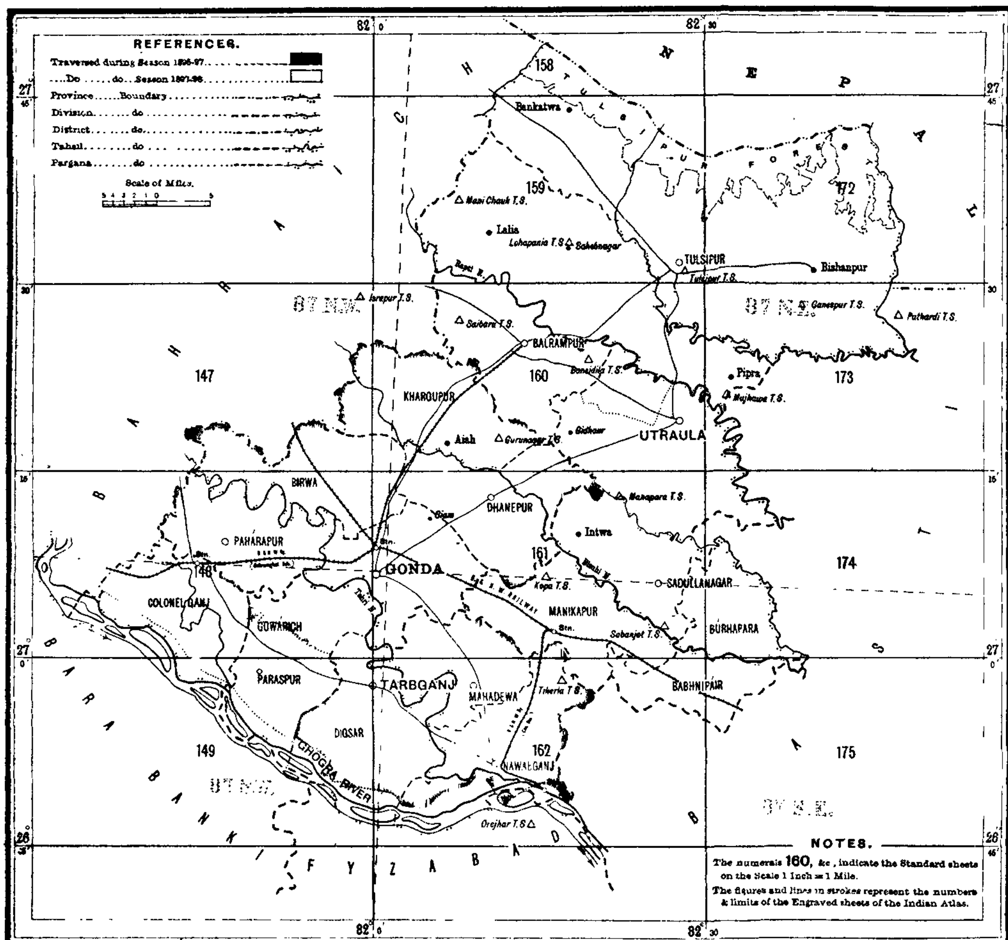
Reg. No. 344. S. I. D. — Dec. 98 — 550.

Photo. S. I. O. Calcutta.

No. 534-S. 98.

N. W. P. & OUDH SURVEY.

1897-98. **INDEX TO THE TRAVERSE SURVEY IN DISTRICT GONDA.** Nos. 2 & 8 PARTIES.

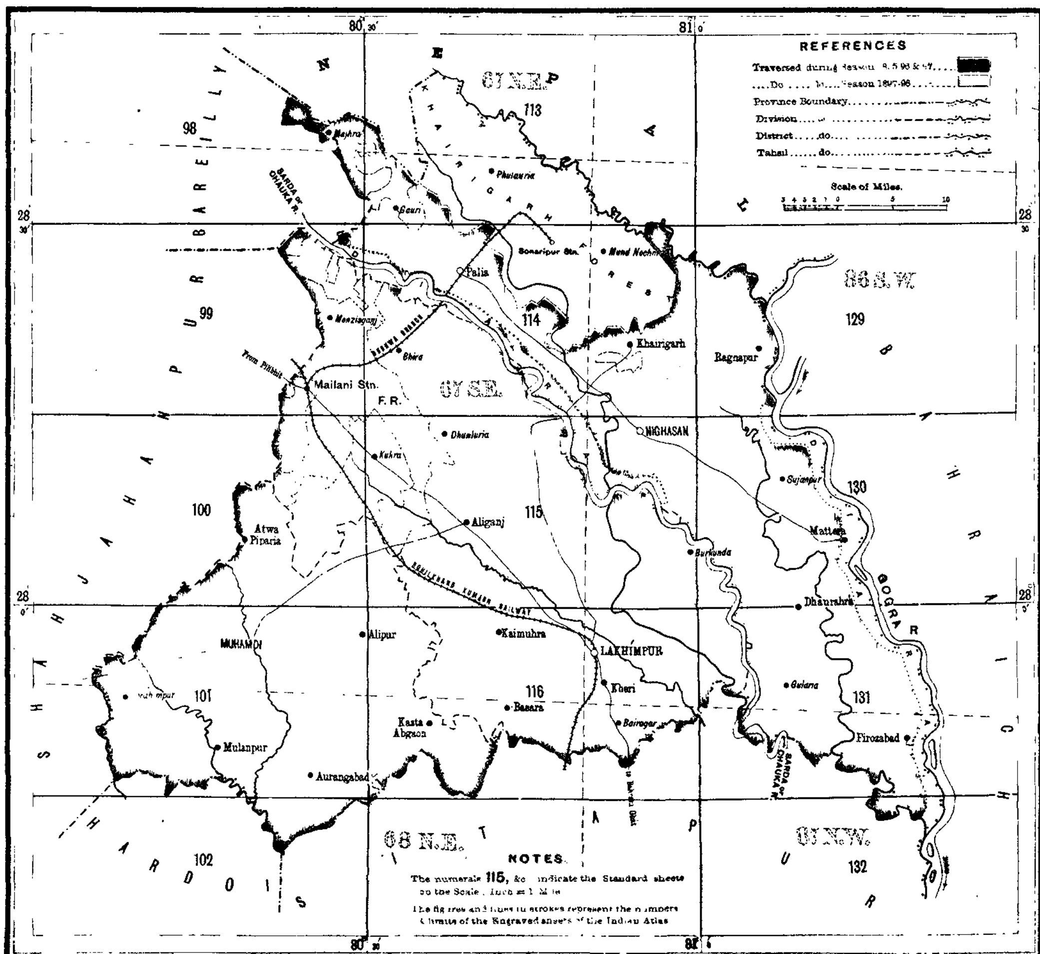


Reg. No. 346, S. I. D.—Dec. 98.—500. Photo. S. I. D., Calcutta.

No. 531-S. 98.

N. W. P. & OUDH SURVEY.

1897-98. **INDEX TO THE TRAVERSE SURVEY IN DISTRICT KHERI.** Nos. 2 & 8 PARTIES.



Reg. No. 345, S. I. D.—Dec. 98.—500 Photo. S. I. D., Calcutta

No. 532-S. 98.

299. The programme for the coming season is as follows :—

The completion of the Bareilly and Kheri districts and of the Naini Tal cultivated tracts, continuation of survey in Gonda, commencement of survey in Farrukhabad, Azamgarh and Pilibhít; all on the 2 years' system, except one *tahsil* of Farrukhabad. The testing of the old village maps of districts Agra and Muttra, the re-demarcation of some pillars on the Nepál-Almora boundary, and the extension of the contour survey of Naini Tal Municipality for the Public Works Department as far as the shaken hill slopes round the brewery.

300. During the season three of the senior survey officers were compelled to go on leave from ill health, and in consequence the paucity of survey officers employed was severely felt. The scheme of placing traverse surveys under Local Governments lately proposed, if carried out, with the proviso that all the assistants are to be interchangeable between traverse and cadastral sections, will, to a great extent, remedy this defect.

In conclusion, the Superintendent would again call attention to the hard and good work done by the several survey officers.

TRAVERSE SURVEYS.

NORTH-WESTERN PROVINCES AND OUDH.

Nos. 2 and 8 Parties.

301. At the close of season 1896-97, Nos. 2 and 8 Parties were amalgamated into one under Government Order No. $\frac{2099}{1-464}$B., dated 5th August 1897, and has been under the charge of Mr. J. S. Pemberton throughout the year. The amalgamation of the two parties was called for by the fact of the annual area, hitherto turned out by the two parties working separately at full strength, being in excess of the requirements of the Land Records Department, and also with a view to reducing the cost of superintendence.

Personnel.

Mr. J. S. Pemberton, Officiating Deputy Superintendent, 1st grade, in charge.
Mr. W. S. Buttress, Extra Assistant Superintendent, 1st grade.
" R. B. Smart, " " " 3rd "
" J. McHatton, " " " 4th "
" T. Shaw, " " " 5th "
" J. Murphy, " " " 5th "
Munshi Aulad Hussein, Sub-Assistant Superintendent, 2nd grade.
Mr. O. C. Ollenbach, " " " 2nd " from 10th November 1897.
Babu Amar Singh, " " " 2nd " from 1st June 1898.
Mr. A. H. Peychers, " " " 2nd " up to 9th May 1898.
Babu Jagdamba Prasad, " " " 3rd "
Mr. C. O'Donel, " " " 3rd "
" C. S. Littlewood, " " " 3rd " from 7th January 1898.
109 Sub-Surveyors, Computers, etc., etc.
1 Hospital Assistant.

302. The changes in the establishment were as follows :—Mr. J. McHatton from head-quarters office and Mr. C. O'Donel from No. 20 Party were transferred to fill the vacancies caused by the absence on leave of Mr. H. T. Hanby, and the transfer of Mr. P. Williams to No. 21 Party. Mr. A. H. Peychers was transferred to the head-quarters office, his place being taken by Babu Amar Singh from No. 7 Party. The newly organised Drawing Office consisted of Messrs. T. Shaw, O. C. Ollenbach, and C. S. Littlewood.

303. The recess offices of the party were closed at Mussooree and Naini Tal between the 15th and 25th October 1897, and field work was started in districts Gonda, Kheri, Azamgarh and Farrukhabad between 10th and 25th November 1897, and in district Pilibhít on the 15th January 1898. The recess offices were re-opened at Mussooree on the 15th April.

304. The programme sanctioned and the work actually carried out was as follows :—

(*a*) Completion of remaining areas in district Pilibhít comprising 189 square miles included in the *pargana* of Jahánabad, and in district Kheri comprising 129 square miles included in detached alluvial lands along the Chauka or Sarda and Gogra rivers.

District Pilibhít was commenced on the 15th January and completed on the 24th March 1898. The attendance of *patwáris* to show the boundaries was unsatisfactory. As in Farrukhabad so in this district, the plan of additional azimuths other than those observed on main and sub-circuits was carried out with equally good, if not better, results.

District Kheri was completed with considerable difficulty, owing to the absence of demarcation, the non-attendance of *patwáris* and the difficult nature of the country for surveying. It took two surveyors the entire season to finish it.

(*b*) District Gonda, 900 square miles, comprised in *parganas* Balrámpur and portions of Tulsipur, Guwárich and Utraula.

This district was commenced on about the 15th November 1897, and completed on the 21st March 1898. A total area of 1,630 square miles remained to be traversed in this district; of this by the terms of the programme, only 900 square miles were required to be done. Owing, however, to a demand by the Land Records Department that the survey of districts Mainpuri and Etah should be started next season, it was found necessary to exceed the programme by 308 square miles, in order not to leave more area than could be completed by the section at work in Azamgarh, in addition to any left unfinished in that district. This would set the Gonda section free to take up the new work.

In *pargana* Guwárich no demarcation had been carried out, and the non-attendance of the *patwáris* to point out the boundaries caused considerable delay and trouble. In other parts of the area traversed the demarcation was better, but still far from good.

The Tulsipur forest reserve to the north of the district, abutting on to the Nepál-Tarái is well demarcated by stone pillars, most of which have been incorporated with the traverse survey, but the values obtained by the forest survey have not been utilized; the Superintendent of Forest Surveys having intimated that they were not reliable, the area remaining for survey, exclusive of forest reserves, is 550 square miles.

(*c*) District Farrukhabad, 956 square miles, in *parganas* Kampil, Shámsabad West and East, Mahammadabad, Pahára, Bhojpur, Chhibrámau and Tálgrám commenced on 10th November 1897 and completed on the 21st April 1898.

A special feature of the work in this district was the excellent state of the demarcation, and the interest taken by the Collector, Mr. E. Galbraith, who saw to the measures adopted for securing the permanency of the traverse stations and the attendance of *patwáris* at time of survey, and that they were given due effect to by the *tahsildárs* and other officials concerned. As an additional check on the angular work beyond the usual azimuth observations on main and sub-circuits, the camp officer, Mr. McHatton, introduced the plan of observing azimuths in the centre of blocks of villages, the bearings of which had already been closed, with very satisfactory results. An excess of 379 square miles, beyond what was required by the programme, was traversed in order to keep down the cost rates which otherwise would have been abnormally high. The area remaining for survey amounts to 398 square miles which will be completed next season.

(*d*) District Azamgarh, 1,138 square miles, in *parganas* Deogaon, Bela Daulatabad, Belhabáns, Nizámabad, Atraulia, Kauria, and Máhul.

Work was commenced on the 25th November 1897 and completed on the 10th April 1898; progress was at first slow owing to the nature of the country, which is under water till the end of December and to the want of demarcation in the submerged tracts. The Collector took active measures to remove this last difficulty, and after the 1st of January 1898 the demarcation was kept well in advance, and no further inconvenience was experienced, 1,005 square miles remain to be traversed in the district which it is expected will be completed next field season.

305. The average size in square miles of village circuits in the several districts traversed is as follows:—district Farrukhabad 0·99; district Pilibhít 0·93; district Gonda 1·23; district Kheri 1·73; district Azamgarh 0·40.

306. Azimuth observations were taken at 424 points on main and sub-circuits in the season's work. With very few exceptions, as in the case of

alluvial lands, main and sub-circuit traverses have been run along *pargana* and *tappa* boundaries. In alluvial lands the main circuits have followed the first line of village boundaries above the high bank of river.

307. The marks used have been the usual prism-headed stones obtained from Chunar and baked clay cylinders locally manufactured. The former have been used as before in marking (*a*) village trijunction points where settlement marks were non-existent, (*b*) one satellite station at every trijunction and (*c*) two consecutive stations between trijunctions a mile or more apart. Cylinders have been used for all other stations. The total number of stones used have been 11,061, and cylinders 43,857. The number left unused and which will be utilized next season, are, stones 1,151, cylinders 9,042. The cost of 5,085 stones purchased during the present season amounts to R1,747 including railway freight, and 44,059 cylinders to R1,171. The local carriage for both descriptions of marks cost R2,605.

308. Traverse charts of every district under survey have been prepared, showing the run of main and sub-circuits with their trijunction points. Azimuth and G. T. S. stations plotted and a table showing their co-ordinate values from origin was also prepared.

309. The plotting done on various scales by the traverse sections during the season is as follows:—

1,517 villages on 28 sheets on the scale of 2 inches=1 mile;
949 „ on 26 sheets „ 4 inches=1 mile;
591 „ on 6,971 sheets „ 16-inches=1 mile;
39 „ on 96 sheets „ 32-inches=1 mile;

310. The party was divided into one Drawing Office and three traverse sections, the latter being in charge of Messrs. Buttress, Smart and McHatton, and the former of Mr. Shaw; combined with the Drawing Office was a small topographical section.

311. The field work of this topographical section was confined to the Lalitpur sub-division of the Jhánsi district, in which the detail survey has been made of 104 square miles, consisting of gaps left between the areas cadastrally surveyed, and which were scattered over an area of 1,189 square miles. Mr. Ollenbach accompanied by two sub-surveyors left Sháhjahánpur on the 31st December 1897, and started field work in the third week of January. The surveys have been made on the scale of 2 inches to the mile, and based on the traverse stations fixed for the cadastral survey. The country surveyed consisted entirely of hills. The vertical interval adopted between the contours was 50 feet and relative heights were all determined by the clinometer. No absolute heights were observed, but this omission will be made good during the ensuing field season, when the remaining area in *parganas* Bánpur and Lalitpur are surveyed. Field work was closed on the 22nd May. The mapping of Lalitpur has been taken in hand first and is now in progress.

The work of the Drawing Office comprised compiling and mapping 2-inch topographical standard sheets, for reduction to half scale from original village plans supplied by the Land Records Department, for which no provision had hitherto been made.

312. The following shows the particulars of the outturn of traverse survey for the season:—

DISTRICTS.	Number of villages and river blocks.	Number of sub-traverses.	Number of traverse stations.	Linear miles of traverse.	Area in square miles.
Farrukhabad	1,316	1,800	21,259	4,808	1,310
Ditto river blocks	19				
Pilibhít	201	269	2,982	743	189
Do. river blocks	10				
Gonda	875	1,076	16,586	3,755	1,081
Kheri	74	41	764	228	128
Azamgarh	2,866	1,158	25,389	5,146	1,143
Oudh blocks	7	...	...	...	...
Villages	5,332	4,344	66,980	14,680	3,851
Blocks	36				

313. The total expenditure for the year ending 30th September 1898 is R1,23,888, *i.e.*, R95,598 for traversing, or R24·13·2 per square mile, R6,539 for stone embedding, or R26·8·4 per square mile for both the above operations. Drawing section expenditure amounts to R17,555, distributed as follows:—detail survey R4,205·8·5, or R40·7·0 per square mile mapping R13,349, of which the rate cannot be calculated.

314. As during the preceding seasons, the *mauza* was the unit in the system of survey adopted, each *mauza* being sub-divided by traverses averaging half a mile apart, the object being the supply of 16-inch skeleton plots to the Land Records Department with a sufficient number of fixed points to form a good basis, on which *patwâris* could do their detail surveys.

315. During the recess season the Government of the North-Western Provinces and Oudh asked for the preparation of a half inch map of district Sháhjahánpur for local requirements. Proposals for its preparation *pari passu* with that of the standard sheets of that district, and an estimate for the work have been submitted.

The projection of the standard sheets of Sháhjahánpur has been completed, but owing to the village cadastral maps having been received very late from the Land Records Department, very little of the mapping can be done before the close of the present season.

316. The party was inspected in the field by the late Major-General R. G. Woodthorpe, Officiating Deputy Surveyor-General, and the recess office by Major-General C. Strahan, Surveyor-General, and Colonel J. R. Hobday, Officiating Deputy Surveyor-General.*

ASSAM.

No. 6 Party.

317. Captain C. W. H. Symonds, I.S.C., held charge of this party until the 12th September 1898, when he proceeded on one month's privilege leave and Mr. W. H. Penrose assumed temporary charge of the party.

Personnel.

Captain C. W. H. Symonds, I.S.C., Officiating Deputy Superintendent, 1st grade, in charge up to 12th September 1898.
Mr. W. H. Penrose, Extra Assistant Superintendent, 5th grade, in charge from 13th September 1898.
Mr. F. S. Bell, Sub-Assistant Superintendent, 1st grade.
31 Permanent and 23 temporary Sub-Surveyors, Computers, etc.

318. The recess office was closed at Shillong on the 6th November 1897 and field operations commenced at Tezpur on the 15th idem. A detachment under Mr. Penrose, detailed for traversing the boundaries of *ilam* lands and waste land grants in Sylhet and Cachar districts, left Shillong on the 7th October, and commenced field work at Sylhet on the 16th November 1897.

319. The programme was the completion, as far as possible, of the different operations detailed in Revenue and Agricultural Department No. 3906, dated 16th October 1896, and which had been commenced in the field season of 1896-97. It consisted of:—

(1) Traverse and detail survey on 2-inch scale of all gaps existing between previous cadastral surveys and the riverain of the Brahmaputra river.
(2) Traverse of tea grants.
(3) Traverse of all villages, both those which had been already cadastrally surveyed by local agency, and also those which remain for survey by the same agency.
(4) The survey in the Sylhet and Cachar districts of about 200 square miles.
(5) Detail survey on a scale of 32 inches to the mile of the Cherra Poonjee coal mines,

* The officer in charge reports that Messrs. W. S. Buttress, R. B. Smart, J. McHatton and T. Shaw have conducted their duties in a most satisfactory and able manner, specially mentioning Mr. R. B. Smart, and that Messrs. J. Murphy, O. C. Ollenbach, Munshi Aulad Hussein, Babu Amar Singh, Babu Jagdamba Prasad, Messrs. C. O'Donel and C. S. Littlewood have rendered efficient service. Of the native establishment, Sanat Kumar Chatterjee, Monohar Lall, Latifulla Khan, Kanhia Lal, Dharani Dhur Mukerjee, Jowla Pershad I, Annada Pershad, Mohadeo Ram, Mumtaz Ali, Mohomed Ali, Basant Rai, Gokul Chand. Ramphal, Abdulla Khan, Krishna Prosad Chatterjee, Fani Bhusan Rai and Enayetulla are commended.

ASSAM SURVEY.

1897-98. **INDEX TO THE CADASTRAL SURVEY IN DIST. SYLHET.** No. 6 PARTY.

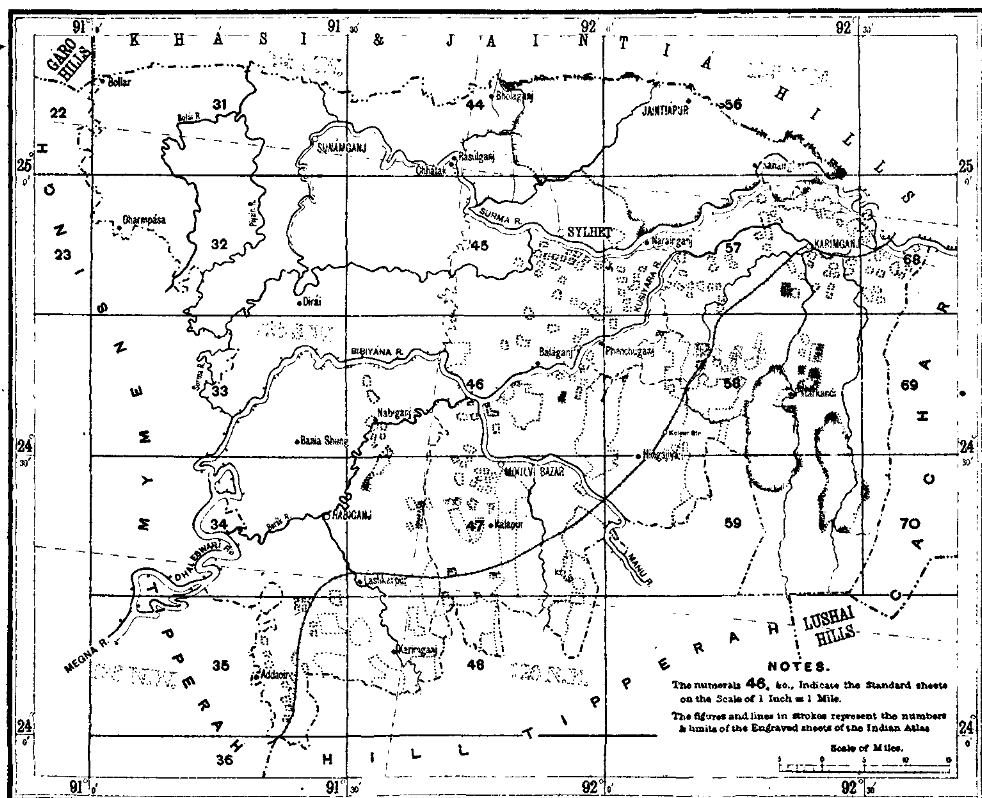


Photo. S. I. D., Calcutta.

REFERENCES.

Previously Surveyed
Traversed in Season 1896-97
Traverse of Boundary of Ilam Lands, Season 1897-98
Traverse of Grants, Season 1897-98
State...... Boundary
District....... do
Sub-Division do

Reg. No. 391, S I D—Jan. 99—550.

No. 402-S. 99.

No. 6 PARTY.

ASSAM SURVEY.

1897-98.

INDEX TO THE CADASTRAL & TOPOGRAPHICAL SURVEY IN DISTS. KAMRUP, DARRANG, & NOWGONG, &C.



No. 403-S. 99.

320. The statement below will show the area contained in the programme and the area actually completed :—

	Area to be completed.	Area actually completed.
Assam Valley.	Square miles.	Square miles.
(1) 2-inch topographical survey	1,045·1	901·8
(2) Traverse of tea grants	118·2	127·1
(3) Traverse of villages surveyed by local agency in extension of the cadastral survey	237·4	68·2
Sylhet and Cachar.		
(4) Traverse of *ilam* and waste-land grants	200·0	176·6
(5) 32-inch survey of the Cherra Poonjee coal mines	3·0	3·0
TOTAL	1,603·7	1,276·7

From the above it will be seen that the area surveyed under head 2 is in excess of the original programme by 8·9 square miles, but that the area surveyed under heads 1, 3 and 4 falls short of the original programme by 335·9 square miles. The following remarks will explain the reason of the short-outturn :—

No. 1.—Refers partly to small areas omitted from the original cadastral surveys which lie to the south-east, south, and south-west of Gauháti. At the commencement of the season an attempt was made to traverse these portions, but it was found that the country was inundated and unhealthy, so that the line cutters had to be withdrawn and employed on the north bank of the Brahmaputra river. At the close of the field season, as soon as the riverain of the Brahmaputra had been surveyed on the 2-inch scale, another attempt was made to complete these small portions, but failed owing to the prevalence of cholera, small pox and fever. These areas will be completed during the coming field season.

No. 3.—Originally it was thought that, after running sub-traverses through these groups of villages and picking up as many trijunction points as possible, sufficient points would have been available to enable the boundaries and topographical details to be reduced by pentagraph on to the 2-inch standard sheets. But it was found impossible to run these sub-traverses owing to the ignorance of the *mandals* and their inability to point out the trijunction marks or even the boundaries of their villages. Another attempt was made late in the season to survey them topographically, using the stations of the old 16-inch cadastral survey, but that again was found to be impracticable owing to the fact that (1) a great many of the stations could not be found, (2) that several of those found were not in their true position, the result of their not having been embedded at the time of the survey.

No. 4.—In the Sylhet district the outturn is slightly less than that anticipated. This must be attributed to the scattered nature of the work. In several instances the area of pieces of *ilam* lands does not exceed 1½ to 3 acres, for the survey of which sub-surveyors had to march 20 to 40 miles. The scattered nature of the work may be judged from the fact that the area under survey extended over a tract of country of not less than 6,000 square miles.

321. In the Assam valley the area was divided up into one main circuit, one river circuit and six sub-circuits. In the Sylhet district the area being

scattered no main or sub-circuits were run. In both the Assam valley and district Sylhet two chains were used, and the resulting measurements found to be very satisfactory, with the exception of a small area in south Sylhet which will have to be revised next season.

322. In the Darrang district in the Assam valley all co-ordinates were referred to the origin, consisting of the intersection of longitude 91°30′ and latitude 26°30′, and in the Nowgong district the intersection of longitude 92°30′ and latitude 26°30′. In the Sylhet district the origin of the Jaintia survey was preserved, namely, the intersection of longitude 92° 00′ and latitude 24° 30′.

323. Each subsurveyor was supplied with a spare chain for the purpose of testing his working chain. These testing chains were submitted weekly and checked against the standard steel bars kept in the head camp.

324. From the sub-joined statement will be seen the number of times the theodolite was set up and the number of linear miles of chaining which was run in the Assam valley and the Cachar and Sylhet districts:—

Names of Districts.	Number of Stations.	Linear miles of chaining.
Assam Valley	6,867	1,237·8
Cachar and Sylhet	10,051	889·7
Total .	16,918	2,127·5

The angular work was checked by astronomical observations, and the detail survey by 194 linear miles of chaining.

325. In the Assam valley, when traversing those villages which had been already surveyed by local agency, only a certain number of the old trijunction marks were taken up to render it possible to pentagraph the topographical detail on to the 2-inch standard sheets. In the few villages lying in the Assam valley which were traversed with a view to their being subsequently surveyed cadastrally by local agency, all stations were temporarily marked by means of a peg, and at the same time in order to afford a means of readily identifying the stations a small bough of the *semal* tree was planted 5 feet magnetic north of the station. These stations will be permanently marked by the Settlement Department hereafter.

326. In the Assam valley, in all the tea grants and villages traversed for future cadastral survey by local agency, the boundaries were traversed, in the former as shown by the proprietors and managers of gardens, and in the latter as pointed out by the *mandals*. In the Sylhet district all the boundaries of grants and *ilam* lands were previously demarcated by a staff of demarcation *amins* under the direct control of the Settlement Officer. The boundaries were traversed in accordance with the above demarcation. In the traverse of the area topographically surveyed on the 2-inch scale pegs only were used. In the Sylhet and Cachar districts the total number of old and new permanent marks (embedded by the Settlement Department) utilized as theodolite stations was 1,549. The balance, namely, 8,502, were marked by wooden pegs with the usual mound and tree planted 5 feet magnetic north.

327. At the request of the Deputy Commissioner of the Khási and Jaintia hills a topographical survey of the coal mines at Cherra Poonjee was made. Two traces on the scale of 32 inches = 1 mile were supplied to the Administration.

328. The revision survey of 540·5 square miles in Cachar was continued during the past season by an establishment of two *amins* under the direct control of the Settlement Officer of Cachar.

329. A survey training class was opened at Sylhet on the 2nd January 1898 under the supervision of Mr. W. H. Penrose for the purpose of instructing the following officers:—

Mr. S. G. Hart, Assistant Commissioner.
Babu Nagendra Chandra Datta, Probationary Sub-Deputy Collector.
" Mohendra Chandra De, do. do. do.

The above officers all passed after completing the work allotted to them, Messrs. Skinner and Graham also rejoined for the purpose of completing the course of training which was commenced last year. They passed on the 17th February and 5th March 1898, respectively.

330. In the Assam valley considerable difficulty was experienced in getting the *mandals* of villages to point out the boundaries of those villages which had been surveyed by local agency. In most instances they professed themselves absolutely ignorant of the position of the boundaries of villages under their charge. It was owing to the apathy shown by them that it was found necessary to abandon the idea of traversing those villages surveyed by local agency in the Nowgong district. In the traverse of tea grants every possible assistance was received from managers and assistants. In the Sylhet and Cachar districts no obstruction of a serious nature was experienced. A few of the native permanent settlement-holders proved obstructive and delayed the traverse survey to a certain extent.

331. Throughout the whole season the health of the establishment was exceptionally good. In the Assam valley four *khalásis* died from fever and debility, one sub-surveyor Rahimuddin was killed by a wild buffalo while surveying on the Nowgong side of the river. In the Sylhet district four *khalásis* died from fever and one *tindal* from cholera.

332. In consequence of the failure to complete the two years' programme which had been laid down in October 1896, it was suggested that this party should be retained for yet another year. This was sanctioned, *vide* Revenue and Agricultural Department No. 978, dated 21st May 1898. Acting on the instructions conveyed in the above letter, the officer in charge reports that the programme will consist approximately of the following:—

Assam Valley.

No. 1.—Traverse and survey on the 2-inch scale of the riverain of the Brahmaputra and the gaps lying between the meridians of 93° and 95°; also gaps left over on the southern bank from last season's programme. This represents an area of about 1,045 square miles.

No. 2.—Traverse of certain villages which will be surveyed cadastrally by local agency and will cover an area of about 30 square miles.

Sylhet.

No. 3.—Completion of last year's programme in district Sylhet; area remaining is 23·4 square miles.

No. 4.—Demarcation of the boundary between Sylhet and Hill Tippera in the Sátgaon on Balisum hills.*

GEODETIC.

Nos. 22 and 23 Parties, Astronomical.

333. During the season 1897-98 the Astronomical Parties were in Captain Lenox-Conyngham's charge, and Lieutenant Beazeley, R.E., was attached to No. 22 Party.

Personnel.

Captain G. P. Lenox-Conyngham, R.E., Deputy Superintendent, 1st grade, in charge.
Lieutenant G. A. Beazeley, R.E., Assistant Superintendent, 1st grade.
" E. A. Tandy, R.E., Assistant Superintendent, 1st grade, from 15th September 1898.
Babu Hanuman Prasad, Sub-Assistant Superintendent, 3rd grade.
" Govind Balwant Joshi, Computor.
" Lal Singh, "

The programme of work consisted of a resumption of determination of latitude on the group system which had been originated by Lieutenant J. Herschel, R.E., but had been allowed to drop, because Lieutenant Herschel was removed from the work before he had fully elaborated the system.

* The officer in charge reports that both Messrs. W. H. Penrose and F. S. Bell have given entire satisfaction, the latter specially was of great assistance in supervising the 2-inch detail survey and traverse of tea grants, etc., in the Assam valley.

The following members of the native establishment have done good work :—

Fatteh Mahomed, Gholam Hyder Khan, Mohamed Tabrez Khan, Sakhawat Hosain, Sunder Singh, Khurshed Hosain and Rajab Alli.

334. Two improvements are intended to be introduced into the system, namely, a symmetrical arrangement of the stations round the central one, and the addition of the measurement of astronomical azimuths at each.

The Agra longitude station was selected as the central point, and it was surrounded by a quadrilateral figure, the corner stations being respectively north, south, east and west of the centre and 5 miles distant from it.

335. Owing to the difficult nature of the country round Agra, it was not possible to connect the points by a sufficiently rigorous triangulation for the comparison of the observed and computed azimuths to be of value, but the latitude observations led to interesting results, and there seems every prospect that the system when carried out in the light of the experience gained, and in more favourable country will prove highly valuable. The object in view is the determination of the direction and magnitude of the deviation of the plumb line in the area examined.

336. In addition to the regular work of the parties, they were entrusted with the formation of two camps for the parties of scientists who came from England to observe the total eclipse of the sun in January 1898. The native establishment of No. 22 Party was lent to Major Burrard for the camp at Sahdol at which the Astronomer Royal and Professor Turner were the observers, and No. 23 Party with Captain Lenox-Conyngham, and Lieutenant Beazeley undertook that at Pulgáon for Mr. Newall, and Captain Hills, R.E. This caused an interruption from the middle of December till the first week of February, but the time was well spent.

337. During the recess the greater part of Captain Lenox-Conyngham's time was taken up in preparing for the press the records and computations of the Electro-Telegraphic Longitude observations for the connection of Karáchi with Greenwich and in writing the explanatory chapters for inclusion in the volume in which they will be published. The computation of the field season's work was therefore entrusted for the most part to Lieutenant Beazeley and Sub-Assistant Superintendent Hanuman Prasad.

338. Lieutenant Beazeley was transferred in September from No. 22 Party to the Head Quarters' Office, Calcutta, and Lieutenant Tandy was appointed to take his place.

339. The parties were inspected in September by Major Burrard, R. E., Officiating Superintendent, Trigonometrical Surveys.*

TIDAL AND LEVELLING OPERATIONS.

No. 25 Party.

340. Major S. G. Burrard, R.E., remained in charge of the tidal and levelling operations up to the 21st April 1898. When he was transferred to officiate as Superintendent of Trigonometrical Surveys he handed over to Mr. E. J. Connor, who held charge until the 6th May, the day of arrival of Lieutenant H. L. Crosthwait, R.E., who had been on temporary duty at Dehra Dún.

Personnel.

Major S. G. Burrard, R.E., Superintendent, 2nd grade, in charge until 21st April 1898.
Lieutenant H. L. Crosthwait, R.E., Assistant Superintendent, 1st grade, in charge from 6th May 1898.
Mr. G. Belcham, Extra Assistant Superintendent, 1st grade.
" E. J. Connor, " " " 3rd grade, in charge from 21st April to 5th May 1898.
" J. Bond, Extra Assistant Superintendent, 3rd grade.
" J. P. Barker, Officiating Extra Assistant Superintendent, 6th grade.

Surveyors, etc.

Syed Zille Hasnain, Dhondu Venayek, Venayek Narayen, N. V. Apte, 3 native Mechanics, 14 Recorders and Computers.

Tidal Operations.

341. The automatic recording of the tidal curves by means of self-registering gauges, their reduction, and the publication of the tide-tables containing the predicted times and heights of high and low water, have been continued during

* Captain Lenox-Conyngham was satisfied with the work done by the members of the two parties.

the year. The following is a list of stations at which tidal observations have been, and are still being taken. Permanent stations are shown in italics :—

	Stations.	Automatic or Personal observations.	Date of commencement of observations.	Date of closing of observations.	No. of years of observations.	Remarks.
1	Suez	Automatic	1897	Still working	1	
2	Perim	Ditto	1898	Ditto	...	
3	*Aden*	Ditto	1879	Ditto	18	
4	Muscat	Ditto	1893	1898	5	
5	Bushire	Ditto	1892	Still working	5	
6	*Karáchi*	Ditto	1881	Ditto	17	
7	Hanstal	Ditto	1874	1875	1	
8	Navánár	Ditto	1874	1875	1	
9	Okha Point	Ditto	1874	1875	1	
10	Porbandar	Personal	1893	1894	2	
10 A	„	Automatic	1898	Still working	...	
11	Port Albert Victor (Káthiáwádar)	Personal	1881	1882	1	
11 A	„ „ („)	Automatic	......	......	...	
12	Bhávnagar	Ditto	1889	1894	5	
13	*Bombay (Apollo Bandar)*	Ditto	1878	Still working	20	The tide-gauge is the property of Bombay Port Trust.
14	Bombay (Prince's Dock)	Ditto	1888	Ditto	10	
15	Mormugáo (Goa)	Ditto	1884	1889	5	
16	Kárwár	Ditto	1878	1883	5	
17	Beypore	Ditto	1878	1884	6	
18	Cochin	Ditto	1886	1892	6	
19	Tuticorin	Ditto	1888	1893	5	
20	Minicoy	Ditto	1891	1896	5	
21	Galle	Ditto	1884	1890	6	
22	Colombo	Ditto	1884	1890	6	
23	Trincomalee	Ditto	1890	1896	6	
24	Pámban Pass	Ditto	1878	1882	4	
25	Negapatam	Ditto	1881	1888	6	The year 1884-85 is excluded.
26	*Madras*	Ditto	1880 Restarted 1895	1890 Still working	10 3 } 13	
27	Cocanada	Ditto	1886	1891	5	
28	Vizagapatam	Ditto	1879	1885	6	
29	False Point	Ditto	1881	1885	4	
30	Dublat (Saugor Island)	Ditto	1881	1886	5	
31	Diamond Harbour	Ditto	1881	1886	5	
32	*Kidderpore*	Ditto	1881	Still working	17	
33	Chittagong	Ditto	1886	1891	5	
34	Akyab	Ditto	1887	1892	5	
35	Diamond Island	Ditto	1895	Still working	3	
36	Elephant Point	Ditto	1880 Restarted 1884	1881 1888	1 5 } 6	
37	*Rangoon*	Ditto	1880	Still working	18	
38	Amherst	Ditto	1880	1886	6	
39	Moulmein	Ditto	1880	1886	6	
40	Mergui	Ditto	1889	1894	5	
41	*Port Blair*	Ditto	1880	Still working	18	

342. During the year 1897-98 the observatory at Muscat was closed and the observatories at Perim and Porbandar were finally completed by the kind co-operation of Major A. Speed, R.E., Executive Engineer, Aden Military Works, and Mr. J. B. Benson, State Engineer, Porbandar, and their registrations were started. In 1898-99 no observatories are to be closed. The observatory at Port Albert Victor, where the building work has been unavoidably postponed, will, if possible, be opened.

343. In addition to the automatic registrations made during the year at the 13 stations enumerated above, personal tidal observations to graduated staves were taken at Bhávnagar, Colombo, Tuticorin, Chittagong, Akyab, and Moulmein, with the object of comparing the actual times and heights of high and low water with those predicted in the tide-tables. No such observations have been made at any of the other closed stations since the automatic registrations ceased, and it is not known if the predictions continue accurate. The method at present in use for making comparisons by means of tide-pole observations has not proved satisfactory, but a scheme is under consideration for its improvement.

344. All the tidal observatories in operation during the year were inspected either by Major Burrard, Lieutenant Crosthwait or Mr. Belcham, portable meteorological instruments being taken by them for testing those working, locally.

345. The tidal observatories on the whole have all worked very satisfactorily at Diamond Island a fortnight's curves were not recorded owing to the annual cleaning of the pipe and cylinders, but otherwise the registrations are perfect and it is hoped that communication between the sea and the float cylinder will remain free until the completion of the term of observations.

346. The reduction of the tidal observations has been carried on steadily during the year: observations for the year 1897 at 12 stations have been reduced, and there are no arrears. The usual work in connection with the preparation of the tide-tables for 1899, which will contain the predictions of high and low water at 38 ports, has been satisfactorily got through.

347. In the following statements are summarised the percentage of error in the predicted times and heights of high and low water for the last 8 years :—

PERCENTAGE OF ERROR IN PREDICTED TIMES AND HEIGHTS AT OPEN COAST STATIONS FROM AUTOMATIC OBSERVATIONS.

Year.	No. of Stations.	In Time. Within 15 minutes of Actuals.		In Height. Within 8 inches of Actuals.		In Height. Within $\frac{1}{10}$ of mean range at Springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1890 . .	13	69	70	95	93	91	91
1891 . .	10	74	73	94	87	98	97
1892 . .	8	75	74	91	85	98	98
1893 . .	9	73	68	93	98	96	95
1894 . .	10	65	62	95	92	97	95
1895 . .	9	68	65	98	97	94	94
1896 . .	9	71	70	97	97	97	93
1897 . .	8	71	75	96	97	97	97
Average of 8 years.	10	71	70	95	93	96	95

PERCENTAGE OF ERROR IN PREDICTED TIMES AND HEIGHTS AT RIVERAIN STATIONS FROM AUTOMATIC OBSERVATIONS.

YEAR.	No. of Stations.	IN TIME.		IN HEIGHT.			
		Within 15 minutes of Actuals.		Within 8 inches of Actuals.		Within $\frac{1}{10}$ of mean range at Springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1890 . .	3	53	55	64	63	90	86
1891 . .	3	64	58	66	66	92	92
1892 . .	2	61	60	72	65	94	95
1893 . .	2	57	57	68	50	89	84
1894 . .	2	56	55	66	42	88	80
1895 . .	2	59	55	74	47	94	84
1896 . .	2	56	55	63	42	87	74
1897 . .	2	59	61	75	57	96	91
Average of 8 years.	2	58	57	69	54	91	86

348. Bushire, treated as an open coast station, is the only port where the predictions are not good, as will be seen from the table given below. It was thought that the meteorological conditions prevailing in the Persian Gulf had caused the peculiarities exhibited by the tidal curves, but though several tests were applied no connection could be found between them. Mr. E. Roberts, of the Nautical Almanac Office, has been furnished with tracings of the tidal curves, and he proposes to treat the predictions in a similar manner to that adopted for riverain ports; it is, therefore, proposed to keep the Bushire Observatory open until the accuracy of his method can be tested.

PERCENTAGE OF ERROR IN PREDICTED TIMES AND HEIGHTS AT BUSHIRE, OPEN COAST STATIONS.

YEAR.	No. of Stations.	IN TIME.		IN HEIGHT.			
		Within 15 minutes of Actuals.		Within 8 inches of Actuals.		Within $\frac{1}{10}$ of mean range at Springs.	
		H. W.	L. W.	H. W.	L. W.	H. W.	L. W.
1895 . .	...	45	41	80	54	69	45
1896 . .	...	58	44	77	70	73	62
1897 . .	...	57	37	85	88	78	81
Average of Open Coast Stations.	10	71	70	95	93	96	95

SPIRIT-LEVELLING OPERATIONS.

349. No levelling operations were carried on by this party during the past field season, the levelling detachment being employed on revisionary triangulation in Assam.

350. During the approaching field season the levelling operations will be resumed and the detachment under Mr. Bond will be employed in completing the main lines of levels between Katni and Allahabad and Katni and Sironj; and, if possible, the line connecting Bidar and Bhopál will be started.

Assam Revisionary Triangulation.

351. The regular levelling operations of this party, under Mr. Bond, were postponed to admit of the detachment being employed on the revision of the triangulation in the Khási and Gáro hills, owing to alleged changes in their position, due to the earthquake of 12th June 1897.

352. Mr. Bond's instructions were to re-observe the horizontal angles of the Eastern Frontier Series, and to re-determine heights of stations, with a view to ascertaining what effect the earthquake had produced on the triangulation, and also, if possible, to ascertain the seat of seismic disturbance. It was found, however, that the disturbed area was very much more extensive than at first anticipated, and that the work was never outside the affected locality. Mr. Bond's results are therefore only relative. A lateral displacement seems to have taken place towards the north-west, varying from 2 to 12 feet, apparently indicating that the centre of the core of the earthquake lies about midway between the Eastern Frontier and Brahmaputra Series. The heights of stations exhibit changes, showing in some cases a subsidence of 4 feet or an upheaval of 24 feet.

353. Mr. Bond's Narrative Report is given in the Appendix, and with it a chart illustrating his operations.

The detachment commenced observations at Cherra Poonjee and carried the work northwards along the Eastern Frontier Series. The observations were taken with Troughton and Simm's new 8-inch micrometer theodolite. The mean triangular error, which ranged between $1''\cdot57$ and $5''\cdot82$, was $3''\cdot41$. In connection with the work, observations were taken at three topographical survey stations with an Everest's pattern 8-inch vernier theodolite.

354. The season's outturn was as follows:—

Horizontal and vertical angles were taken at 13 stations, fixing the positions of 22 and the heights of 25 old stations. The series extended over a direct distance of 50 miles and embraced an area of 1,020 square miles.

The triangulation was carried across the Khási hills, where the earthquake was most felt, and where numerous landslips and extensive fissures were met with everywhere, particularly along the courses of rivers and streams. The roads and bridle-paths were greatly damaged and in many cases destroyed. In the course of the operations the party had to ascend and descend bare landslip slopes from 1,500 to 2,000 feet in height, and to cross over steep narrow wedge-shaped ridges with landslips on either side, extending to depths ranging from 600 to 1,000 feet, which were in many places dangerous. Mr. Bond reports that throughout his whole sojourn in Assam earthquakes were of continuous occurrence and he is of opinion that the hills may still be undergoing slight changes.

355. In addition to the regular departmental work of the tidal and levelling party, a considerable amount of extra work had to be undertaken to furnish other departments and Local Governments with information applied for by them.

356. The recess office of this party was inspected by the Superintendent, Trigonometrical Surveys, in January 1898.*

* Lieutenant Crosthwait reports favourably of Messrs. Belcham, Connor, and Barker and Surveyor Dhondu Venayek in the tidal section, and of Mr. Bond and Surveyor Syed Zille Hasnain employed on the revisionary triangulation. The staff of mechanics, sub-surveyors, and computers are reported to have worked well.

TABULAR STATEMENTS.

Summary of the outturn of work of the

Scale of Survey.	No. of Party.	Locale of field operations	Triangulation. Instruments used. Diameter in inches.	Area in square miles.	Square miles to each point trigonometrically fixed.	Square miles to each height.	Secondary. Stations fixed.	Secondary. Triangular error in seconds.	Secondary. Error per mile in feet.	Tertiary. Intersected points.	Tertiary. Error per mile in feet.	Spirit-levelling operations. Miles levelled over.	Permanent bench-mark stones embedded.	Trigonometrical stations connected with.
Inches to a mile. 64	4	Samastipur Municipality (Darbhanga).	...	...	...	...	...	...	...	...	...	...	...	...
32	6	Cherra Poonjee Coal Mines	...	...	...	...	...	...	...	...	...	...	...	...
16	2 & 8	Farrukhabad	5 & 6	...	...	...	...	...	...	...	...	...	...	...
		Pilibhít	5 & 6	...	...	...	...	...	...	...	...	...	...	...
		Gonda	5 & 6	...	...	...	...	...	...	...	...	...	...	...
		Kheri	5 & 6	...	...	...	...	...	...	...	...	...	...	...
		Azamgarh	5 & 6	...	...	...	...	...	...	...	...	...	...	...
	3	Myingyan	6	...	...	...	...	...	...	...	...	...	...	...
		Minbu	6	...	...	...	...	...	...	...	...	...	...	...
		Maymyo (Mandalay)	6	...	...	...	...	...	...	...	...	...	...	...
		Katha	6	...	...	...	...	...	...	...	...	...	...	...
		Lower Chindwin	6	...	...	...	...	...	...	...	...	...	...	...
	4	Noákháli	...	...	...	...	...	...	...	...	...	...	...	...
		Sáran	...	...	...	...	...	...	...	...	...	...	...	...
		Darbhanga	...	...	...	...	...	...	...	...	...	...	...	...
		Muzaffarpur	...	...	...	...	...	...	...	...	...	...	...	...
		Patna (Railway Ghát Survey).	...	...	...	...	...	...	...	...	...	...	...	...
	6	Sylhet and Cachar	...	...	...	...	...	...	...	...	...	...	...	...
	7	Toungoo	...	...	...	...	...	...	...	...	...	...	...	...
	17	Ahmednagar and Násik (Bombay).	...	...	...	...	...	...	...	...	...	...	...	...
	Forest Branch.	Saugor	...	...	...	...	...	...	...	...	...	...	...	...
		Biláspur	...	...	...	...	...	...	...	...	...	...	...	...
		Nágpur and Wardha	...	...	...	...	...	...	...	...	...	...	...	...
		Seoni	...	...	...	...	...	...	...	...	...	...	...	...
		Chhindwára	...	...	...	...	...	...	...	...	...	...	...	...
	Land Records Survey.	Bahraich	...	...	...	...	...	...	...	...	...	...	...	...
		Sháhjahánpur	...	...	...	...	...	...	...	...	...	...	...	...
		Bijnor	...	...	...	...	...	...	...	...	...	...	...	...
		Kheri	...	...	...	...	...	...	...	...	...	...	...	...
		Bareilly	...	...	...	...	...	...	...	...	...	...	...	...
		Gonda	...	...	...	...	...	...	...	...	...	...	...	...
		Basti	...	...	...	...	...	...	...	...	...	...	...	...
		Total	...	...	...	...	...	...	...	...	...	...	...	...
8	17	Násik, Thána and Kolába	7	718	2·7	2·7	226	11·1	0·27	1,101	0·28	...	...	...
6	15	Ráwalpindi	...	...	...	...	...	...	...	...	...	...	...	...
4	9 & 19	Kurnool	6, 7 & 8	720	3·3	3·2	61	15	0·5	153	0·8	...	...	...
		Cuddapah	6, 7 & 8	900	3·3	3·4	50	18	0·4	221	1·3	...	...	...
		North Coimbatore	6, 7 & 8	1,711	2·8	3·1	107	10	0·5	530	0·9	...	...	...
		Salem	6, 7 & 8	...	...	...	...	...	...	...	...	...	...	...
		South Arcot	6, 7 & 8	...	...	...	...	...	...	...	...	...	...	...
	17	North Kánara	...	...	...	...	...	...	...	...	...	...	...	...
	18	Himálaya	7	527	1·16	1·16	60	9	0·37	402	0·57	...	...	...
	20	Lower Burma (Forests)	5	...	...	...	...	...	...	...	...	...	...	...
	Forest Branch	Saugor	7	730	19·7	13·8	17	...	...	20	1·7	...	...	...
		Biláspur	—	...	...	...	...	...	...	...	...	...	...	...
		Nágpur-Wardha	...	...	...	...	...	...	...	...	...	...	...	...
		Seoni	...	...	...	...	...	...	...	...	...	...	...	...
		Chhindwára	7	503	5·5	5·1	27	8	0·67	65	0·9	...	...	...
		Chamba (Punjab)	7	580	...	...	25	...	...	181	...	...	...	...
		Carried over	...	5,671	...	...	347	...	...	1,572	...	...	...	...

Field Parties during the year 1897-98.

	TRAVERSING.				DETAIL SURVEY.					RECORD WRITING.			REMARKS.
	Area in square miles.	Stations at which the theodolite was set up.	Angular error per station in seconds.	Linear error per mille.	Area in square miles.	Plane-table fixings per square mile.	Linear miles of test lines.	Villages.	Average size of fields.	Area in square miles.	Villages.	Fields.	
...	1	154	...	...	2	...	...	7	0·20	2	7	5,074	
...	3	...	...	...	3	...	...	...	...	...	...	...	
...	1,310	21,259	3	0·15	...	...	...	...	...	...	...	...	
...	189	2,982	4	0·15	...	...	...	...	...	...	...	...	
5	1,081	16,586	4	0·10	...	...	...	...	...	...	...	...	
...	128	764	...	...	...	...	...	...	...	...	...	...	
...	1,143	25,389	1	1·76	...	...	...	...	...	...	...	...	
...	4	219	15	1·30	927	...	2,805	888	1·09	...	...	539,257	
...	23	763	8	0·51	94	...	225	163	0·93	...	...	64,906	
10	25	579	6	1·04	...	...	...	...	...	...	...	...	
...	...	...	...	...	20	...	128	35	0·77	...	...	16,556	
...	764	15,186	3	4·7	425	...	1,014	337	1·50	...	...	161,811	
...	...	...	...	...	10	...	53	6	1·54	10	6	4,254	
...	51	1,613	...	...	582(a)	...	3,123	918(a)	0·30	555	877	1,180,871	(a) Includes 27 square miles = 41 villages surveyed topographically on 16" = 1 mile.
15	598	18,755	...	...	733	...	3,177	965	0·42	733	965	1,100,808	
...	10	...	...	...	9 (b)	...	33	16(b)	3·72	2	5	250	
...	1	94	...	...	1	...	...	3	...	...	...	...	(b) Includes 7 square mile = 11 villages surveyed topographically on 16" = 1 mile.
...	177	10,051	6·2	0·16	...	...	...	...	...	...	...	...	
...	893	19,574	4	0·36	770	...	2,005	376	0·44	...	...	423,365	
20	...	...	...	...	29	321	115	...	...	...	...	...	
...	...	...	...	...	60	112	...	...	...	...	...	...	
...	...	...	...	...	17	59	*in situ*	...	...	...	...	...	
...	...	...	...	...	78	160	127	...	...	...	...	...	
...	...	...	...	...	25	184	60	...	...	...	...	...	
25	...	...	...	...	56	234	78	...	...	...	...	...	
...	...	...	...	...	451	...	...	330	0·4	451	330	693,754	
...	...	...	...	...	228	...	...	275	1·1	228	275	123,904	
...	...	...	...	...	406	...	...	732	0·6	406	732	475,064	
...	...	...	...	...	1,035	...	...	470	0·8	1,035	470	560,237	
30	...	...	...	...	558	...	...	722	0·7	735	958	719,830	
...	...	...	...	...	677	...	...	771	0·4	310	521	528,597	
...	...	...	...	...	85	...	...	118	0·2	1	...	...	

Summary of the outturn of work of the

Scale of Survey.	No. of Party.	Locale of field operations.		Triangulation.									Spirit-levelling operations.		
								Secondary.			Tertiary.				
				Instrument used. Diameter in inches.	Area in square miles.	Square miles to each point trigonometrically fixed.	Square miles to each height.	Stations fixed.	Triangular error in seconds.	Error per mile in feet.	Intersected points.	Error per mile in feet.	Miles levelled over.	Permanent bench-mark stones embedded.	Trigonometrical stations connected with.
Inches to a mile.		Brought forward	...	...	5,671	...	...	347	...	...	1,572	...	...	...	...
	Forest Branch	Dudwa Kheri (Oudh)	...	...	...	...	...	...	...	...	...	...	...	...	...
	Forest Branch	Pyinmana	50	5, 7 & 4½	...	...	...	...	...	...	...	...	...	...	...
	Forest Branch	Tenasserim	...	4 & 7	...	...	...	...	...	...	...	...	...	...	...
	Forest Branch	Ruby Mines	...	7, 8 & 10	804	53·6	53·6	9	8·1	0·34	6	...	...	...	...
		Total	...	...	6,475	...	...	356	...	...	1,578	...	...	...	...
2	2 & 8	Jhánsi (Lalitpur Sub-Division).	...	...	...	...	...	...	...	...	...	...	...	...	...
	6	Kámrúp, Darrang and Nowgong.	...	...	...	...	...	...	...	...	...	...	...	...	...
	12	Kalát and Dera Gházi Khán (Desert Canal Survey).	55	5 & 6	...	...	...	...	...	...	...	...	...	...	...
	12	Sind	...	5 & 6	...	...	...	...	...	...	...	...	...	...	...
	18	Himálaya	...	7	136	1·0	1·0	30	10	...	105	...	...	...	...
	20	Lower Burma (Forests)	...	5	...	...	...	...	...	...	...	...	...	...	...
		Total	...	...	136	...	...	30	...	...	105	...	...	...	...
1	10	Upper Burma	...	6	2,742	4·7	6·4	66	11·7	0·22	492	0·77	...	...	...
	10	Ditto (Katha and Bhamo).	60	6	2,447	46	52	9	5·8	0·69	42	0·5	...	...	...
	11	Upper Burma	...	6	2,873	6·6	6·6	58	14·0	0·23	219	0·82	...	...	...
	14	Lushai Hills	...	6 & 7	2,400	6	9	50	6·9	0·17	204	1·4	...	...	...
	15	Sind (Karáchi and Sehwán)	...	8	1,430	11·4	18·9	16	5·2	0·15	107	0·43	...	...	...
	21	Upper Burma	..	6 & 8	3,256	12·8	20·2	37	11·1	0·22	259	1·6	...	...	...
	Forest Branch.	Chamba	65	...	...	...	...	...	...	...	...	...	...	...	...
		Total	...	...	15,148	...	...	236	...	...	1,323	...	...	...	...
½	3	Prome, Thayetmyo and Henzada.	...	6	2,345	...	...	43	6·1	0·14	127	0·9	...	...	...
	21	Upper Burma	...	...	...	...	...	...	...	...	...	...	...	...	...
		Total	...	...	2,345	...	...	43	...	...	127	...	...	...	...
⅛	15	Persia (sistán)	68	...	...	...	...	...	...	...	...	...	...	...	...
		Grand Total	...	...	24,822	...	...	891	...	.	4,234	...	...	...	...

Field Parties during the year 1896-97—(contd).

	TRAVERSING.				DETAIL SURVEY.					RECORD-WRITING.			REMARKS.
	Area in square miles.	Stations at which the theodolite was set up.	Angular error per station in seconds.	Linear error per mille.	Area in square miles.	Plane-table fixings per square mile.	Linear miles of test lines.	Villages.	Average size of fields.	Area in square miles.	Villages.	Fields.	
...	224	6,244	...	...	3,171	...	231	...	...	...	...	...	
...	...	773	8·3	2·0	75	77	...	...	...	...	...	...	
50	...	1,340	1·1	5·3	277	274	83	...	...	...	...	...	
...	...	1,663	6·5	3·2	104	242	65	...	...	...	...	...	
...	...	1,262	4·7	3·9	89	400	26	...	...	...	...	...	
...	224	11,282	...	...	3,716	...	405	...	...	...	...	...	
...	...	...	...	...	104	...	...	197	...	...	...	...	
...	1,097	6,867	3·7	0·33	902	...	194	85	...	...	...	..	
55	1,554	1,350	5	0·56	1,477	10	641	...	...	...	...	...	
...	2,971	14,498	4	0·42	2,709	17	1,588	...	...	...	...	...	
...	...	...	...	...	259	22	*in situ*	...	...	...	...	...	
...	549	...	2·4	4·1	118	...	13	...	...	...	...	...	
...	6,171	22,715	...	...	5,569	...	2,436	282	...	...	...	...	
...	...	...	...	...	2,116(*c*)	7	94	...	...	...	...	...	(*c*) Includes 205 square miles of overlap survey.
60	...	...	...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	2,571(*d*)	7·6	64	...	...	...	...	...	(*d*) Includes 241 square miles of overlap survey.
...	...	...	...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	1,857(*e*)	...	...	...	...	...	...	...	(*e*) Also 80 miles of boundary demarcation in Kohistán.
...	...	...	...	...	2,595	...	*in situ*	...	...	...	...	...	
65	...	...	...	...	200	9	...	...	...	...	...	...	
...	...	...	...	...	9,339	...	158	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	...	...	...	
68	...	...	...	...	1,752	...	...	...	...	...	...	...	
...	...	...	...	...	1,752	...	...	...	...	...	...	...	
68	...	...	...	...	8,224	...	...	...	...	...	...	...	
...	12,796	167,965	...	...	36,199	...	16,125	7,414	...	4,468	5,146	6,598,538	

Statement showing the cost-rates of work executed by the

Number of party.	Nature and *locale* of field operations.	Cost-rate per square mile.									
		Triangulation.	Traversing.	Detail survey and preparation of maps on scales of							
				¼"	1"	2"	4"	6"	8"	16"	32"
		R	R	R	R	R	R	R	R	R	R
	Topographical Surveys.										
6	Kámrúp, Darrang and Nowgong	...	37·0	...	...	13·1	...	...	...	...	444·3
6	Sylhet and Cachar	...	31·7	...	...	...	...	...	...	...	...
10	Upper Burma	13·2	...	...	21·9	...	...	...	...	...	...
11	Ditto	15·3	...	...	19·1	...	...	...	...	...	...
12	Sind	...	9·7	...	...	13·1	...	...	...	...	...
14	Lushai	37·4	...	...	...	...	...	...	...	...	...
15	Sind	7·0	...	...	16·7	...	...	175·4	...	...	...
18	Himálaya	11·5	...	...	...	53·4	107·5	...	...	...	...
21	Upper Burma	11·3	...	4·3	18·3	...	...	...	...	...	...
	Forest Surveys.										
9 & 19	Coimbatore	13·2		...	...	...	72·6	...	...	...	...
9 & 19	Kurnool	15·6		...	...	...	122·5	...	...	...	...
9 & 19	Cuddapah	11·2		...	...	...	...	...	...	...	...
9 & 19	Salem	...	23·7	...	...	...	67·6	...	...	...	...
9 & 19	South Arcot	...	69·8	...	...	...	54·4	...	...	...	...
17	Bombay	7·9	...	...	...	...	60·2	...	178·7	154·5	...
20	Lower Burma	...	56·3	...	...	80·8	192·7	...	...	...	...
Forest Branch.	Central Provinces	7·1	...	...	...	...	41·3	...	...	...	...
Forest Branch.	Punjab	8·5	...	...	19·9	...	50·5	...	...	...	...
Forest Branch.	Burma	17·3	...	...	...	...	90·7	...	...	...	...
	Cadastral Surveys.										
3	Myingyan	...	43·5	...	...	...	...	...	...	98·6	...
3	Minbu	...	101·3	...	...	...	...	...	...	77·1	...
3	Lower Chindwin	...	81·5	...	...	...	...	...	...	121·3	...
3	Katha	...	...	...	...	...	...	...	...	117·6	...
3	Mandalay	...	43·4	...	...	...	...	...	...	...	...
3	Prome, etc.	6·1	...	...	...	...	...	...	...	...	...
4	Noákháli	...	...	...	...	...	...	...	...	...	...
4	Sáran	...	108·0	...	...	...	...	...	...	31·3	...
4	Darbhanga	...	37·0	...	...	...	...	...	...	85·9	...
4	Muzaffarpur	...	108·3	...	...	...	...	...	...	74·9	...
7	Toungoo	...	57·6	...	...	...	...	...	...	74·0	...
										142·9	
	Traverse Surveys.										
2 & 8	Farrukhabad	...		...	...	...	...	...	...	...	...
2 & 8	Pilibhít	...		...	...	...	...	...	...	...	...
2 & 8	Azamgarh	...	24·8	...	...	...	...	...	...	...	...
2 & 8	Gonda	...		...	...	...	...	...	...	...	...
2 & 8	Kheri	...		...	...	...	...	...	...	...	...

several Field Parties during the year 1897-98.

	Cost-rate per acre.	Cost-rate per square mile.			Total cost, inclusive of charges for instruments to Provincial Governments.	Remarks.
	Cadastral survey, including traversing, detail survey and mapping.	Stone embedding.	Records (*Khanapuri*).	Completion of vernacular records, assessment statistics, etc.		
	Annas.	R	R	R	R	
...	...	...	...	...	70,281(*a*)	
...	...	...	...	...	14,304(*b*)	
...	...	...	...	...	85,179(*c*)	
...	...	...	...	...	88,608	
5	...	...	...	...	1,10,276	
...	...	...	...	...	91,687(*d*)	
...	...	...	...	...	95,769(*e*)	
...	...	...	...	...	67,698(*f*)	
...	...	...	...	...	81,761	
10	...	...	...	...	45,307	
...	...	...	...	...	37,719	
...	...	...	...	...	10,696	
...	...	...	...	...	25,065	
...	...	...	...	...	10,596	
15	...	...	...	...	76,107(*g*)	
...	...	...	...	...	1,31,267	
...	...	...	...	...	60,209(*h*)	
...	...	...	...	...	12,258(*i*)	
...	...	...	...	...	64,152(*j*)	
20	3·55	1·8	...	7·7	98,634	
...	4·46	7·4	...	7·7	10,465	
...	5·07	5·2	...	7·7	1,21,034	
...	2·94	...	...	7·7	2,595	
...	...	1·7	...	...	1,128	
25	...	...	...	...	19,974(*k*)	
...	...	...	55·5	4·9	2,441(*l*)	
...	4·85	...	57·9	46·4	1,14,014(*m*)	
...	2·80	...	51·0	27·3	1,53,739(*n*)	
...	4·56	...	89·3	1·3	3,800(*o*)	
30	5·01	...	...	...	1,83,352(*p*)	
...	...	...	...	...	...	
...	...	...	...	...	...	
...	...	1·7	...	...	1,23,888(*q*)	
...	...	...	...	...	...	
35	...	...	...	...	...	

(*a*) Includes R1,415 expended on demarcation; R7,470 expended on completion of cadastral maps; R2,120 expended on 2" mapping; R4,415 expended on field statistics; R1,015 expended on training of officers; R150 expended on miscellaneous works for Settlement Officer and Director, Land Records.

(*b*) Includes R5,075 cost of revision survey in District Cachar; R3,613 expended on 2" mapping.

(*c*) Includes R7,128 cost of triangulation of the Frontier extension series.

(*d*) Includes R2,000 expended on instruction of surveyors, etc.

(*e*) Includes R1,267 expended on Quetta Revision Survey; R28,902 on mapping and R4,600 on Kach Settlement.

(*f*) Includes R13,263 expended on arrears of mapping; R2,522 on Náhan Town Survey; R355 on revision of Jumna bank survey; and R3,245 on instruction of Soldier Surveyors, etc.

(*g*) Includes R2,740 expended on traversing.

(*h*) Includes R4,531 expended on levelling.

(*i*) Includes R708 expended on Bashahr mapping.

(*j*) Includes R7,592 expended on traversing 211 linear miles.

(*k*) Includes R3,422 expended on revision of Shwebo maps and R2,153 in Azimuth observations of Meiktila and Yaméthin local survey.

(*l*) Includes R509 expended on Rosnabad badars; and R262 expended on arrears of work in District Midnapore.

(*m*) Includes R3,646 expended on 16" Diára Topographical Survey; R446 expended on demarcation in Kachnar Mahal; and R103 expended on Champáran Traversing.

(*n*) Includes R2,696 expended on revision work; R18 expended on 16" Diára Topographical Survey; R684 expended on 64" survey of Samastipur Municipality; R1,826 expended on demarcation of Bhágalpur-Purnea Nepál Boundary and R3,791 on Bihar badars.

(*o*) Includes R981 expended on 16" Diára Topographical Survey; R334 expended on arrears of traversing; R95 expended on survey of Govindpur Terarasia; R1,763 on Orissa badars and revision work; and R152 on Patna Railway Ghát Survey.

(*p*) Includes R7,817 expended on demarcation; R6,463 expended on Rangoon Town; R3,688 expended on 2" mapping of District Amherst and R8,858 expended on revision survey and 2" traces of District Pegu.

(*q*) Includes R4,197 debitable to late No. 2 Party; R4,205 expended on 2" detail survey of 104 square miles in District Jhánsi, giving a rate of R40·4 per square mile; and R13,349 charge of North-Western Provinces Drawing Office.

Particulars of Cadastral Surveys completed since 1896-97.

District.	Scale of survey.	Number of villages.	Number of fields.	Area surveyed.	Average size of fields.	Cost, exclusive of demarcation and charge for instruments.	Rate per square mile. Traverse survey.	Rate per square mile. Cadrastral survey.	Rate per square mile. Cadastral survey with Record of Rights.	By whom and when surveyed.
				Sq. miles.	Acre.	R	R a. p.	R a. p.	R a. p.	
Minbu	16″ = 1 mile	815	753,045	1,400	1·2	280,506	57 14 5	138 5 2	...	Messrs. W. H. Patterson, G. H. Cooke, E. G. Little and E. J. Jackson during 1892—94 and 1896—98.
Bijnor	16″ = 1 mile	732	475,064	406	0·6	33,337	25 9 1	...	56 10 4	Traverse survey done by Mr. J. S. Pemberton during 1896-97. Cadastral survey done by Land Records Surveys.
Sháhjahánpur	16″ = 1 mile	2,365	1,332,737	1,738	1·1	149,996	29 11 10	...	56 9 9	Traverse survey done by Mr. J. S. Pemberton during 1895—97. Cadastral survey done by Land Records Surveys.
Bahraich	16″ = 1 mile	1,996	2,908,299	2,265	0·5	207,965	22 10 8	...	59 5 3	Traverse survey done by Mr. J. S. Pemberton during 1894—96. Cadastral survey done by Land Records Surveys.

PART III.

THE OPERATIONS AT THE HEAD-QUARTERS OFFICES.

357. These offices comprise—

(1) The Head-Quarters Offices at Calcutta.
(2) The Trigonometrical Branch Office at Dehra Dún.
(3) The Drawing Office at Simla.
(4) The Forest Survey Branch Office at Dehra Dún.

A description of the work carried on in each office is given below :—

I.—HEAD-QUARTERS OFFICES, CALCUTTA.

SUPERINTENDENCE, CORRESPONDENCE AND ACCOUNTS.

Superintendence.

Major-General C. Strahan, R.E., Surveyor-General of India.
Colonel J. E. Sandeman, I.S.C., Deputy Surveyor-General in charge Revenue Branch (on furlough up to 2nd September 1898).
Major-General R. G. Woodthorpe, C.B., R.E., Officiating Deputy Surveyor-General, in charge Revenue Branch, from 10th November 1897 to 26th May 1898.
Lieutenant-Colonel J. R Hobday, I.S.C., Assistant Surveyor-General from 10th November 1897 to 12th June 1898. Officiating Deputy Surveyor-General in charge Revenue Branch, up to 9th November 1897 and again from 27th May 1898; confirmed 3rd September 1898.
Major F. B. Longe, R.E., Officiating Assistant Surveyor-General up to 9th November and on special duty up to 18th November 1897.
Major W. J. Bythell, R.E., Officiating Assistant Surveyor-General, from 13th June to 6th August 1898.
Captain H. A. D. Fraser, R.E., Officiating Assistant Surveyor-General, from 8th August 1898.
Mr. T. W. Babonau, Registrar.

Correspondence.

Mr. T. A. Milne, Head Assistant.
" G. C. Walker, Head Clerk.
Babu Kalipodo Banerji, Clerk.
" Beni Madhab Banerji, Clerk.
" Chuni Lal Dey, "
" Durga Narayan Ghosh, "
" Ramkristo Chunder, "
Mr. H. E. D'Cruz, Clerk, on leave from 15th November 1897.
Babu Gopal Chunder Dass, Clerk.
" Kali Kristo Chunder, "
and seven others.

Accounts.

Mr. C. O. Gray, Head Clerk.
Babu Raj Krishna Mukerji, Clerk.
" Hem Nath Dutt, "
and nine others.

358. The general direction of these offices remained in the hands of Major-General C. Strahan, R.E., throughout the year. The Revenue Branch Section was under Lieutenant-Colonel J. R. Hobday, I.S.C., up to 9th November 1897, under Major-General R. G. Woodthorpe, C.B., R.E., up to 26th May 1898, when he died, and again under Lieutenant-Colonel Hobday, from 27th May up to the close of the year. The services of Colonel J. E. Sandeman, I.S.C., having been replaced at the disposal of the Military Department, Lieutenant-Colonel Hobday was confirmed as Deputy Surveyor-General from 3rd September 1898. The General and Topographical Branch Sections were under Major F. B. Longe, R.E., up to 9th November 1897, under Lieutenant-Colonel Hobday up to 12th June 1898, under Major W. J. Bythell, R.E., up to 6th August and under Captain H. A. D. Fraser, R.E., up to the close of the year.*

* The Assistant Surveyor-General reports as follows :—

Mr. T. W. Babonau has continued to perform with credit the duties connected with the general superintendence of the office.

Messrs. Milne and Gray have superintended their respective sections very satisfactorily, and Mr. J. A. Vallis has carried out the arrangements for the despatch of survey *khalásis* to Burma in a satisfactory manner. The native clerks have done well, more especially Babus Beni Madhab Banerji, Chuni Lal Dey, Doorga Narayan Ghose, Ram Kristo Chunder, Raj Krishna Mukerji, Gopal Chunder Dass and Norendro Nath Mukerji.

The Deputy Surveyor-General, Revenue Branch, reports that his Head Clerk, Mr. G. C. Walker, conducted his work in a very efficient manner, and that the native clerks, Babus Kalipodo Banerji and Kanti Chunder Sen are deserving of special mention.

DRAWING OFFICE.

359. The Drawing Office continued under the superintendence of Mr. A. E. Spring throughout the year.

SECTION I.—GEOGRAPHICAL, DRAWING, AND COMPILATION.

360. During the year under review a few changes have taken place in the *personnel* and organization of this section. Mr. J. R. Adels retired on pension on the 6th April; Mr. R. C. Sinclair left on 12th May on deputation to Siam, where he died on 16th July. The vacancies thus caused were filled up by the appointment of Mr. E. W. Stark and Mr. A. S. Nelson.

Personnel.

Mr. W. Stotesbury, Chief Draftsman.

Extra Assistant Superintendents and Sub-Assistant Superintendents on duty.

Mr. A. G. Wyatt, Extra Assistant Superintendent, 2nd Grade, from 27th April 1898.
„ T. H. Rendell, Extra Assistant Superintendent, 3rd grade, up to 27th March 1898.
„ J. A. Barker, Extra Assistant Superintendent, 4th grade.
„ G. E. Parker, Extra Assistant Superintendent, 5th grade, up to 4th January 1898.
„ J. Campbell, Extra Assistant Superintendent, 5th grade.
„ S. O. Madras, Sub-Assistant Superintendent, 1st grade.
„ A. H. Peychers, Sub-Assistant Superintendent, 2nd grade.
„ C. C. Byrne, Sub-Assistant Superintendent, 3rd grade.

Mr. W. Green, Draftsman.
„ A. J. Musgrove „
„ J. R. Adels „ up to 6th April 1898.
„ R. C. Sinclair up to 12th May 1898.
„ A. S. Bateman „
„ A. J. Wilson „
„ C. L. Green „
„ E. W. Stark „
„ A. S. Nelson „

Native Draftsmen.

Babu Purna Chandra Sen.
Munshi Muttyullah up to 17th August 1898.
„ Rahim Baksh up to 20th September 1898.
Babu Sarat Chandra Chatterjee.
„ Narendra Nath Mukherjee.
„ Subodh Chandra Sarkar.
„ Sarat Chandra Coomar and 28 others.

361. During the year the amalgamation of the three drawing offices, *viz.*, Calcutta, Simla and Dehra, was effected and all the draftsmen, both European and Native, have been put on to one list.

362. This Section has as usual been employed to a very large extent in dealing with the compilation of the maps of the several frontier series; of those of the North-Eastern Frontier series, sheets Nos. 15 N. E. (3rd edition), 23 N. W. (8th edition), and 23 S. E. (2nd edition) on the 4-mile scale were brought up to date and published; sheet No. 23 S. W. (8th edition), parts of sheets Nos. 23 N. W. and N. E. on the 4-mile scale, as well as sheet No. 23 (2nd edition) on the 8-mile scale, were corrected and brought up to date. Of the South-Eastern Frontier series, sheets Nos. 1, 2, 3, 4, 5, 6 and 8, on the 8-mile scale were also added to, corrected, and brought up to date; and the following published: sheet No. 1 N. E. (6th edition), No. 1 N. W. (5th edition), No. 2 S. E. (5th edition), sheet No. 2. N. W. (2nd edition), No. 2 S. W. (2nd edition), No. 5 N. W. (5th edition), all on the 4-mile scale; also sheet No. I. (5th edition) on the 8-mile scale.

363. The standard sheets of Upper Burma on the 1-inch scale have been added to, by the publication of sheet No. 306 with additions and corrections to date; sheets Nos. 314 and 359 were completed and published; and sheet No. 268 (2nd edition) is at present under publication.

364. The standard sheets of the other provinces on the 1-inch scale which were added to, changes made in boundaries and otherwise brought up to date, were as follows: of Bengal, 3 sheets; Central India and Rájputána, 7 sheets; Central Provinces, 4 sheets; Hyderabad, 1 sheet; Punjab, 1 sheet; and 2 sheets of the Bombay series on the 2-inch scale were also completed and published, *viz.*, Nos. 199 N. E., and 199 S. E.; and 3 sheets of Central India and Rájputána, and 4 sheets of Central Provinces are still in hand.

365. Among the General maps, those which might be specially mentioned here are.—The 3rd edition of the 32-mile map of India which was brought up to date and sent to press for publication; Burma and adjacent countries on the 32-mile scale; India, 32-mile scale, showing railways; India, 32-mile scale, showing canals; India, 32-mile (skeleton); also India, 128-mile scale, and India, 256-mile scale, were all brought up to date and completed. A new Railway Map of India on the 32-mile scale, showing railways and steamer stations, was put in hand and is nearing completion for press; this map is to take the place of the old 64-mile map hitherto used, as the scale has been found too small and the map is now too crowded with names of stations, so much so, that it is difficult

to make any more additions to it. Another map of India on the same scale (32-mile), showing railways on the different gauges, canals in blue, and hills in grey, was also newly prepared for the Military Department and sent to press; this map will be published during the coming year.

366. The provincial maps of India on the 16-mile scale were all more or less added to and brought up to date, that of Bengal, Bihar and Orissa had the hills brush-shaded and sent for engraving. The map of the Madras Presidency is still under compilation from material supplied by the Madras Revenue Survey and will be ready for publication early next year. The divisional map of Tenasserim was brought up to date and published, and 17 district maps were also revised and brought up to date.

367. Of the sheets of the Atlas of India, 77 passed through various stages, such as additions made to railways, roads, canals, boundaries, and names, etc., 8 of which had the hills brush-shaded and sent for engraving.

368. The maps for the Administration Reports of the several Provincial Governments, which were attended to, were those of the Punjab and Upper Burma, that of Assam had the hills brush-shaded and sent for engraving; also 25 district maps on the 8-mile and 16-mile scales were corrected and added to, those of Chhindwára, Mirzápur, and Hoshiárpur had the hills added in brush-shading for engraving.

369. Of the cantonment and city plans, 91 were corrected and brought up to date, from recent data supplied by the Military Works Department or Local Governments.

370. In addition to the preparation of the 32 Index maps required for this report, a large number of special maps were prepared and printed for the Military Department; being mostly maps of cantonments including the country within a radius of 12 miles, also maps to illustrate the Famine Report of Bengal, the Famine Report of the Central Provinces, the Sanitary Commissioner's Report on cholera and mortality in Central Provinces; 4 sets of the map of India on 192-mile scale, showing the quinquennial progress of education 1892-97, for Home Department; also 14 maps in connection with the work of the Burma-China Boundary Commission.

371. The colouring of 1946 maps as office copies and for other Departments was also accomplished. A large amount of professional data was supplied to various officers and to the Portuguese Government of Goa. The correspondence in connection with the work of this section still keeps increasing, no fewer than 2,500 letters having been received and answered during the year under report.

SECTION II.—REVENUE.

372. The work of this section consists in examining and preparing for photozincography, the fair maps received from the field parties of the Revenue Branch; in bringing up to date, and re-publishing the old maps; in the preparation of the index maps for field parties and for the General Report; in colouring maps on various scales; in tracing maps, furnishing plans, and supplying data to Government Officials and others. The examination of the field books, and azimuth computations, etc., on which the several Revenue Surveys are based, is also done in this section.

Personnel.

Mr. T. Shaw, Head Draftsman, up to 11th December 1897.
" G. Campbell, do. do. (*sub. pro tem.*), from 12th December 1897 to 12th April 1898.
" E. P. S. Hill, Head Draftsman, from 13th April 1898.

Sub-Assistant Superintendents on duty.

Mr. H. W. Biggie, Sub-Assistant Superintendent, 2nd grade, up to 1st April 1898.
" H. H. B. Hanby, Sub-Assistant Superintendent, 2nd grade, from 20th February 1898.
" P. K. Vaughan, Sub-Assistant Superintendent, 2nd grade, from 16th October 1897.

Native Draftsmen.

Munshi Abdúl Azíz.
" Abdúl Ruzzaq.
Babu Tincory Sen.
" Bacharam Banerjea.
" Ram Chunder Sen and 20 others.

Sub-Surveyor, etc., on duty.

Babu Rhedoy Chunder Das.

373. Of the maps of district Pesháwar (Punjab) reported on last year in paragraph 409, the drawing of four sheets on scale 1 inch = 1 mile for reproduction to full scale was finished, and two of them are passing through press; the compilation of the remaining sheets is in progress.

374. One sheet of district Montgomery (Punjab) has been recompiled from the old

pargana maps on scale of 1 inch=1 mile for republication on full scale, and passed with final press order, and one printed sheet of this district has also been corrected to true standard form and sent to press for reprint.

375. Three sheets of district Hissar and five sheets of district Umballa and Karnál were corrected up to date, and additions to boundaries, roads, etc., made thereto; and eleven sheets of district Dera Gházi Khán were revised as to their boundaries from materials furnished by the Settlement Officer.

376. The old sheets of the North-Western Provinces, previously printed without village boundaries, were completed from five sets on scale 2 inches=1 mile, and corrected up to date from information supplied by local authorities, and were sent to press for reduction to scale 1 inch=1 mile; besides this a large number of sheets of this Province, Bengal, Bombay and Lower Burma on scale 1 inch=1 mile were also corrected and brought up to date, for republication from materials supplied either by the district officials or from data obtained from latest surveys.

377. Corrections have been made in spelling of names and details of nine sheets of districts Hooghly and Howrah, on scale 2 inches=1 mile for a new issue on scale 1 inch=1 mile; the typing of the sheets is well advanced.

378. Of the sheets of district Tavoy (Lower Burma) reported on last year in para. 410, the drawing and typing of two sheets (in 8 sections) were finished and other two sheets are nearing completion.

379. Three large scale plans of the cities of Cawnpore on the 12-inch scale, Allahabad and Lucknow on the 6-inch scale were corrected, and additions made thereto from information supplied by the Executive Engineer and Military authorities, and a map of Calcutta city with suburbs (in two sections) on scale 6 inches=1 mile is being recompiled from the materials of the last Calcutta and Dihi-Panchánnagrám surveys. A map of Moulmein Town (complete in 8 sheets) on scale 400 feet=1 inch has been corrected and published; the same map (complete in 69 sheets) on scale 50 feet=1 inch has also undergone corrections, of which 50 sheets were published last year and the remaining 19 are in press.

380. One sheet embracing the northern section of the map of Calcutta and surrounding country has been compiled from the sheets of districts Hooghly, 24-Parganas and Nadia on scale of 1 inch=1 mile, and the two southern sections of the same were corrected up to date from the materials furnished by the local authorities. The whole was published as a third edition.

381. In addition to the above, a large amount of mapping has, as usual, been done for other departments. A special map of Narhan estate has been compiled from the sheets of district Monghyr on scale of 1 inch=1 mile for reduction to ¼ inch scale, for the Director of Land Records and Agriculture, Bengal, and a plan in two sections on scale of 4 inches=1 mile of Naiháti Municipality was prepared for the Chairman of that Municipality.

382 The traverse computations of districts Amherst and Palámau extending over eight seasons were thoroughly examined during the year. Traverse data, calculation of areas and such like information has, as usual, been prepared in this office, and supplied to field parties and district officials. Of traverse data, 589 pages were copied and supplied. A traverse of Captain Anderson's survey of the Nepál boundary along the Province of Oudh was prepared from his field-book of 1859-60 for record and use of this office. Latitudes, Longitudes and direct distances of revenue survey points in districts Nimár, Hoshangabad, Prome, Tharrawaddy and Henzada were calculated, also bearings and distances of *pucka* pillars on the Bhután and Assam boundary and of points of the Hooghly river survey. An area statement showing the areas of all the districts in the North-Western Provinces and Oudh was prepared for North-Western Provinces Government. The areas of districts Dera Gházi Khán, Dera Ismáil Khán, Bannu and Hazára of the Punjab according to *parganas* and *tahsils* were calculated, and the area of district Puri according to *parganas* by summation of villages was prepared and supplied. The co-ordinates of all triple junctions of villages of districts Prome, Tharrawaddy and Henzada falling in Burma standard sheets Nos. 179 and 181 were calculated and plotted from one common origin. Traverse circuits and *pardahs* of two groups of villages were calculated and plotted, and congregated village maps prepared and supplied to the Collector of Nadia. Eighty-six tracings of sheets and forty-nine tracings of village

plans were also made and supplied to district and other officers. Fifty maps on various scales were coloured. Eleven thousand four hundred twenty-seven maps coloured in Map Record and Issue Office for stock were examined in this section.

During the year under report a large amount of correspondence was dealt with by this office, the total number of letters being 1,265.

SECTION III.—CADASTRAL.

Personnel.

Mr. W. H. D. Ewing, Sub-Assistant Superintendent, 1st grade.

Permanent Establishment.

6 Draftsmen.
1 Writer.

Temporary Establishment.

6 Tracers.
3 Moharrirs.

383. This section is employed in preparing the original maps of all cadastral surveys for photozincography and zincography. The maps to be examined are, on receipt of the originals, submitted to a cursory examination in order to see that the sheets are in every respect fit for reproduction.

384. In the North-Western Provinces the returns for the previous year showed 3,939 sheets of district Garhwál remaining to be published, and during the year 3,306 sheets of the same have been published, so the balance of 633 sheets remain to be printed during next season; of these 450 sheets have been prepared for publication.

385. In Burma the returns for the previous year showed 1,214 sheets remaining to be published, and during the past 12 months 1,808 sheets of districts Katha, Kyauksè, Meiktila, Magwe and Mandalay of Upper Burma and Pegu of Lower Burma were received from Parties; out of these 1,114 sheets of the same have been published, leaving a balance of 1,908 sheets remaining to be printed; of these 500 sheets have been prepared for publication.

386. In Assam the returns for the previous year showed 71 sheets remaining to be published and during the past twelve months 304 orginal sheets of district Cachar were received; out of these 311 sheets have been published during the year, leaving a balance of 64 sheets remaining to be printed; of these 50 sheets have been prepared for publication; 5 sheets of district Kámrúp were published. Those remaining incomplete are districts Kámrúp (8 sheets), Sibságar (8 sheets), and Sylhet (45 sheets). These are mostly blocks and waste lands, and, under existing orders, are not to be printed.

The total number of maps passed for publication during the year was 4,800: of which 4,731 were actually printed, 3,526 having been photozincographed and 1,205 zincographed. At the close of the year there were remaining to be published 2,666 sheets against 5,285 sheets in last year, showing a decrease of 2,619 sheets.

387. The services of 3 *moharrirs* were sanctioned by the Board of Revenue to do all the *badar* corrections of district Tippera which was supplied to this office by the Settlement Officer; of this 900 original sheets have been corrected of the northern and central divisions of the district.

388. In addition to this a good deal of miscellaneous work for Collectors, Settlement Officers and others has been done.

SECTION IV.—BENGAL PROVINCIAL.

Personnel.

Mr. E. P. S. Hill, in charge from 1st October 1897 to 13th April 1898.
Mr. A. B. Smart, in charge from 14th April to 30th September 1898.
Mr. P. K. Vaughan, from 1st October to 5th November 1897.
Mr. C. C. Byrne, from 18th April to 30th September 1898.

Permanent Establishment.

6 Draftsmen.

Temporary Establishment.

6 Computers, Writer, etc.
5 Draftsmen.

389. The Cadastral maps dealt with during the year under report were those of Bihar, Orissa, and Chittagong.

For Bihar, 1,672 Cadastral maps were received during previous years and were reduced by pentagraph to the scale of 2 inches = 1 mile for the completion of the standard sheets; there were received during the year 1,062 maps.

390. The reduction of 4,864 cadastral maps of Orissa

received during previous years, to the scale of 2 inches=1 mile was completed during the year under report, this completed the reduction of the Orissa maps.

391. From Chittagong 3,264 cadastral maps were received, of which 1,120 were reduced to the scale of 2 inches=1 mile, the total number of sheets dealt with of Chittagong reached 1,844, of which 727 were received during previous years.

392. For Bihar 44 sheets have been outlined and completed. The interior details of 56 were examined and 16 were finally examined and forwarded to the Photographic Office for reduction to the scale of 1 inch=1 mile. The outlining of 56 sheets has yet to be dealt with though several have been plotted, and the details of a number reduced by pentagraph.

The publication of the Orissa standard maps has for some time been brought to a standstill owing to numerous unsettled boundary disputes and the non-return of the proof sheets from the Settlement authorities. The outlining of four sheets was completed during the year under report. The publication of the Chittagong standard maps will be taken in hand during the current year. The 26 sections on the scale of 2 inches=1 mile of the Orissa standard sheets containing irrigated areas, specially called for by the Government of Bengal, have not yet been published owing to the numerous additions that are being made to them at the request of the Canal Department.*

ENGRAVING OFFICE.

393. Mr. A. E. Spring held charge of this office throughout the year. Mr. T. B. Rodger, who had been on furlough on medical certificate, was invalided in November 1897. Mr. A. R. Coard was on furlough to Europe till 25th September 1898.

Personnel.

Mr. A. E. Spring, Assistant Surveyor-General in charge.
" J. Fulford, Head Engraver.
" S. M. Coard, Engraver.
" T. B. Rodger, " retired November 1897.
" A. W. N. James, "
" A. R. Coard, " on furlough.
" E. Earle, "
" F. R. C. Scallan, "
" E. C. V. Ollenbach, "
" L. H. Musgrove, "
" A. T. Vieux, "
" A. E. W. Cann, "
" H. H. Green, "
30 Native engravers.
1 Apprentice "

Copper-plate Printing Section.

Mr. W. T. Collins, Copper-plate Printer.
" A. E. Pilley, Assistant Copper-plate Printer and Store-keeper.

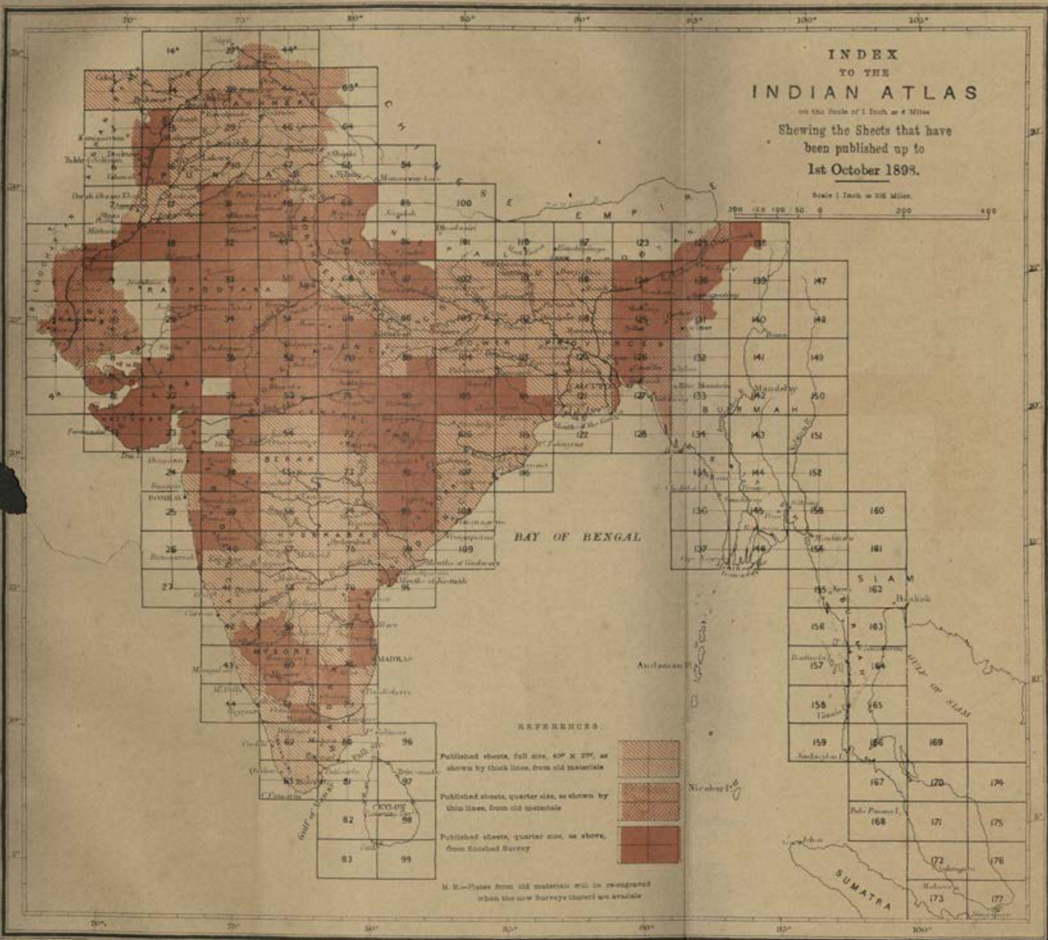
394. The outturn of work for the year has been very satisfactory, it being in excess of last year in all items except outline; but many sheets were under correction for accentuating the village names, and this work accounts for the slightly less outturn in that branch.

395. The sheets published during the year are six quarter atlas sheets, fourteen district maps for administration reports, the 16-mile map of Gujarát (with hills), four plates of a daily weather report for the Photo-Litho. Office, a scale plate containing 5 scales, and 2 tint plates.

396. Sixty-five unpublished quarter atlas sheets in various stages of progress have been added to and corrected, 63 published quarter sheets and 26 full plates have been brought up to date for printing, and 25 quarter sheets have been projected and borders cut. In all 310 plates have been in hand.

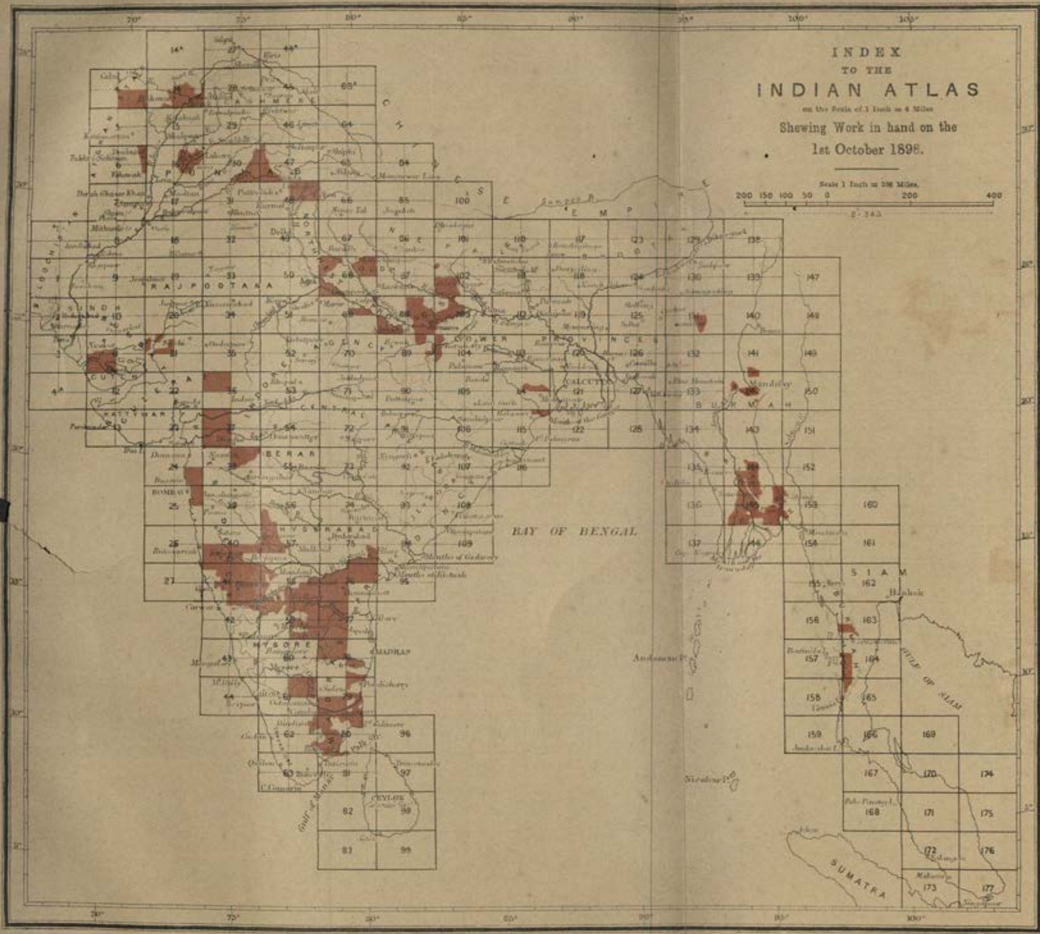
397. The map of India, 128 miles, has been brought up to date, a matrix and duplicate taken and the hills put in hand on the original plate. The 256-mile map has also been brought up to date. Of the 16-mile provincial maps, Bengal, in 2 sheets, has been nearly completed in outline and writing as far as material supplied, but there are still blank portions in each sheet waiting to be filled in with the latest available material, Bombay has been completed as far as material supplied, Madras has been completed in outline and writing as far as material supplied in all sheets but No. 5, which is waiting the return of the duplicate plate to complete the Travancore State, the four sheets of Punjab and Kashmír without hills have been in hand to bring them up to date for publication, and good progress has been made with them, sheet No. 2 of the hill edition is well advanced, the two sheets of Rájputána have had additions made to them.

* Mr. Stotesbury and Mr. Hill in their posts as Chief and Head Draftsmen, respectively, supervised their establishments very efficiently. Messrs. Wyatt, Smart and Ewing have also done well as heads of the Examining, Bengal Drawing, and Cadastral Sections. Mr. Madras has also done very good work. The European draftsmen have been well reported on, especially Messrs. Green and Musgrove, and of the Native Establishment, Babus Purna Chandra Sen, Sarat Chandra Chatterji, Narendra Nath Mukerji, Subodh Chandra Sarkar, Bepin Behari Ghose, Tincory Sen, Bach aram Banerji, Abdul Azziz, Abdur Razzaq, R. C. Sen, and Habibhur Rahman, amongst others, have rendered good service.



Litho., S. I. O., Calcutta.

No. 408-S. 94



Litho., S. I. O., Calcutta.

No. 407-S. 94.



Photo-Block. Survey of India Offices, Calcutta, March 1899.

STATUE IN CALCUTTA

of

Field Marshal Lord Roberts of Kandahar,

V.C., G.C.B., G.C.S.I., G.C.I.E.,

COMMANDER-IN-CHIEF OF HER MAJESTY'S FORCES IN INDIA.

From November 1885 to April 1893.

398. Two provincial maps for administration reports have been added to and 21 district maps for the same, besides the 14 mentioned as published, have been in hand; four sheets of the plan of Calcutta, 16 inches=1 mile, and a plan of Simla and Jutogh have had corrections carried out on them. The Index chart to the Great Trigonometrical Survey and two Indian weather charts have been added to. Forty-eight plates have had the titles and footnotes engraved for the Photo-Litho. Office.

399. The Copper-plate Printing Section has printed 25,971 impressions, which is in excess of the last four years and about as much as this Section can turn out with its present staff. The Steel-facing Section has dealt with 245 plates, which is more than treated last year.*

THE PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE.

400. Mr. T. A. Pope remained in charge of this Office throughout the year. On the 24th May 1898 the Office lost the services of Mr. J. Harrold, Photographer, who retired on pension after an efficient service of 22 years. Four old members of the native staff also retired on pension during the year, *viz.*, Munshis Abdul Futtah and Elahi Bux, draftsmen, and Tamizuddin, zinc corrector, and Babu Kedarnath Ghose, clerk. The first three had all rendered excellent service for periods of over thirty years, and the last had completed 38 years and was a most useful clerk.

Owing to Mr. Harrold's retirement, Mr. R. George, Photographer, who had been acting as Storekeeper, was placed in charge of the Transfer-printing Section, and Mr. A. B. Carville, head clerk, took charge of the Stores Section.

401. The following is an abstract of the year's outturn of work in each section of the Office:—

Personnel.

Mr. T. A. Pope, Assistant Surveyor-General in charge.

NORMAL ESTABLISHMENT.

LITHOGRAPHIC AND PRINTING DIVISION.

Mr. R. Fogarty, Head Assistant.
" A. J. J. Rodrigues, Head Draftsman.
Babu Ambica Charan Mookerjee, Draftsman.
Munshi Abdool Mujeed, Examiner.
1 Apprentice, 28 draftsmen, and 6 colourists.

Lithographic and Zinc Printing Section.

Mr. E. A. LeFranc, Head Printer.
" D. Deas, Chromo-Litho-Printer.
" S. U. Ravenscroft, Assistant Printer.
1 Apprentice, 2 machine printers, 15 litho and zinc printers, 9 machine men, 17 spongemen, 40 pressmen, 1 paper wetter, 2 stone grainers, 2 stone polishers, 4 zinc grainers, 1 ink grinder, 1 engine-driver, and fireman.

Type Printing Section.

Mr. E. De Pyvah, Head Printer, 12 compositors, 3 type printers, 3 inkmen, 3 mates, 2 machine type printers, 2 machine inkmen, 1 impositor, 1 roller-moulder and 1 boy.

PHOTOGRAPHIC AND GENERAL DIVISION.

Mr. J. Harrold, Photographer, up to 24th June 1898.
" C. J. Meade, Assistant Photographer.
" F. N. Murphy, ditto.
" N. J. Gonsalves, ditto.
Munshi Habibul Hossain ditto, up to 23rd June 1898.
Munshi Abdul Rahman, Assistant Photographer, from 1st July 1898.
6 Assistant Photographers and 8 labourers.

Heliogravure Section.

Mr. A. W. Turner, Photo-engraver.
1 Apprentice, 1 Assistant Photo-engraver, 1 engraver, 1 Assistant engraver, 4 copper-plate printers, 6 pressmen, and 11 plate polishers.

Correspondence, Stores and Account Section.

Babu Kanny Lall Sen, Storekeeper.
Mr. A. B. Carville, Head Clerk.
Babu Kedar Nath Ghose, clerk, up to 31st January 1898.
" Khetter Mohan Dass, clerk, from 1st February 1898.
" Gopal Chunder Mookerjee, clerk.
" Surja Kumar Banerjee, clerk.
" Rajani Kanta Chatterjee clerk.
4 Clerks and 1 paper-keeper.

CADASTRAL ESTABLISHMENT.

Photographic Section.

Mr. H. Haward, Head Assistant.
" R. George, Photographer.
" L. Lagnier, ditto.
" J. Lloyd, ditto.
" J. Vieux, Assistant ditto.
7 Assistant Photographers and 10 labourers.

Zinc Printing Section.

Mr. F R. Vandyke, Zinc Printer.
" J. B. Mackenzie, ditto.
" P. Michael, Assistant Zinc Printer.
Babu Khetter Mohan Dass, clerk, up to 31st January 1898.
" Ganoda Persad Pal from 1st February 1898.
1 Clerk, 9 zinc correctors, 9 zinc printers, 10 spongemen, 17 pressmen, and 11 zinc grainers.

* Mr. Spring reports that the Head Engraver, Mr. Fulford, has as usual given great satisfaction in the discharge of his duties. Both the European and Native engravers and the Copper-plate Printer have given entire satisfaction.

General Abstract of work done during the year 1897-98.

Classification.	Sheets or Subjects.	Negatives and transparencies.	Photo-zincographic and Lithographic Printing. Photo-transfer prints.	Zinc Plates transferred.	Zinc Plates printed.	Stones.	Pulls.	Number of copies. Coloured.	Uncoloured.	Total.	Type Printing. Pages or Items.	Pulls.	Copies.	Silver and other Printing. Silver Prints.	Blue Prints.	Heliogravure and Electrotyping. Heliogravure Plates.	Heliogravure Prints.	Photo-Blocks.	Electro types.	Value. R a. p.
Departmental maps	785	1,081	1,152	422	339	50	161,253	23,386	132,769	156,155	13,819	1,176,837	700,756	230	1,306	8	2,521	7	13	58,654 0 3
Cadastral maps	4,477	3,288	3,443	4,649	4,649	...	103,530	...	94,328	94,328	...	...	...	...	...	...	...	...	...	56,335 14 3
Extra-Departmental maps, etc.	1,102	873	566	316	578	474	580,779	101,455	343,874	445,329	...	...	...	53	868	93	71,280	75	...	77,937 9 6
Totals	6,364	5,212	5,161	5,387	5,566	524	845,562	124,841	570,971	695,812	13,819	1,176,837	700,756	283	2,174	101	73,801	82	13	1,92,927 8 0
Totals of 1896-97	7,880	6,372	5,794	6,438	6,749	544	853,945	144,074	708,998	853,072	10,054	931,543	529,664	354	3,267	131	72,246	...	13	2,13,517 14 9
Differences	−1,516	−1,030	−633	−1,051	−1,183	−20	−8,383	−19,233	−138,027	−157,260	+3,765	+245,294	+171,092	−71	−1,093	−30	+1,555	+82	...	−20,590 6 9

There was a falling off in the number of original subjects received for reproduction, which is chiefly due to the large reduction in the number of cadastral sheets sent in by the field parties; though the number of maps and other subjects, both departmental and received from other departments, is also somewhat smaller than last year. The total number of copies printed from zinc and stone amounted to 695,812, against 853,072 last year, though the number of pulls is nearly the same, *viz.*, 845,562, against 853,945 last year. The decrease in the number of copies printed is in cadastral maps and extra-departmental subjects, there being a large increase in the number of departmental maps printed. The proportion of subjects of which only a small number of copies are required seems to be yearly on the increase, and it is therefore impossible to estimate the total amount of work done by the number either of pulls from the machines and presses or of finished copies printed, as the amount of time and labour involved in getting a stone or plate ready for printing is the same whether the number of copies printed be 100 or 10,000. The Type-printing Section shows a large increase over last year, the number of pages or items set up being 13,819, against 10,054, and of copies 700,756, against 529,664. The Heliogravure Section also shows an increase in the number of photogravure prints, though a smaller number of plates was etched, *viz.*, 73,801 prints from 101 plates, as against 72,246 prints from 131 plates last year. A large quantity of work which would formerly have been turned out by the photogravure process was this year printed from half-tone blocks made by the enamelline process. Eighty-two half-tone blocks were prepared by this process, and 8,100 prints made from them in the Type-printing Section, thus relieving to some extent the strain on the copper-plate printing staff. The number of hand-engraved plates electrotyped was thirteen—the same as last year. Less work was done in the Silver-printing Section, the outturn both of blue prints and silver prints being smaller than last year.

402. Among the more important departmental publications dealt with during the year, the following may be specially mentioned :—

Additions and corrections continued to be made to the six sheets of the third edition of the map of India, with hills, on the 32-mile scale. In February 1898 the Government of India sanctioned the publication of this map. There were at that time considerable additions to be made to each of the sheets, and when these were completed it was necessary to pull retransfers from all the stones and put them down on zinc. This was due to the fact that the stones, having been several years under correction, had become quite unprintable. The new plates of sheets Nos. 1 and 4 will require a good deal of touching up after retransferring, but it is practically certain that the map will be finally published during December 1898.

Of provincial maps, the skeleton map of the Punjab and surrounding country, on the 32-mile scale, has been published and 650 copies were supplied. Two maps of Bengal, Bihar, Orissa, and Chota Nágpur were published during

the year, one on the 16-mile scale, and the other on the 32-mile scale, the former being photozincographed, and the latter lithographed. Two hundred copies were printed off of each.

The following district maps were printed off:—Sháhabad, 4 sheets; Peshâwar, 6 sheets; Sylhet, 11 sheets, and Ráwalpindi, 4 sheets, all on the 1-inch scale. Also district maps of Bogra, Darbhanga, Nadia, Pabna, Champáran, Darjeeling, Gaya, Howrah and Palámau on the ¼-inch scale, and sheet No. 6 of the map of the 24-Parganás on the 1-inch scale, all of which were reprinted from stone or zinc.

Two hundred and twenty-one standard sheets of the Topographical and Revenue Surveys, on the 4-inch, 2-inch, 1-inch, ½-inch and ¼-inch scales, were taken in hand during the year either for reprinting or as new publications. Eighty-two plates were printed off, comprising 48 sheets on the 1-inch scale, and including 1 of Balúchistán, 2 of Bengal, 3 of Bombay, 10 of Upper Burma, 3 of Lower Burma, 13 of Central India and Rájputána, 3 of the Central Provinces, 8 of the Indus River survey, 1 of Hyderabad, 1 of the North-Western Frontier, 1 of the North-Western Provinces and Oudh and 2 of the Punjab. Of the Trans-frontier surveys, 6 sheets on the ¼-inch scale and 2 sheets on the ⅛-inch scale of the S.E. Frontier, and 1 sheet on the ½-inch scale of the N. E. Frontier were printed off. Twenty-one sheets of the Lower Burma Survey on the 4-inch scale, and 4 sheets of the Balúchistán survey on the ½-inch scale, were also printed off.

The following city and cantonment plans were printed off:—Map of Simla and Jutogh, on the 6-inch scale; city and cantonment of Jubbulpore, on the 8-inch scale, and Sipri, on the scale of 500 feet to the inch. Maps of the cantonment of Allahabad (in 9 sheets, on the 12-inch scale), and Bareilly (in 21 sheets, on the 16-inch scale) were photozincographed.

The following miscellaneous departmental publications may be mentioned:—A map of Hswe Htame (Wa country), on the ½-inch scale; various maps and sketches illustrating the operations of the Tirah Field Force; a map of the Yunnan frontier, Upper Burma, on the ¼-inch scale, with hills in brown; a map pertaining to the Northern Party, Burma-China Boundary Commission, in 3 sheets, on the 1-inch scale, with hills in brown, and a reconnaissance map on the ¼-inch scale of the same country. As usual, a considerable number of sheets of the forest surveys in Madras were photozincographed and printed off. A number of maps, diagrams and eye-sketches were also reproduced for the report on the total eclipse of the sun issued by this Department.

403. The number of subjects received from other departments and dealt with during the year was 1,102, as against 1,197 last year, and the number of copies printed 445,329, against 600,702.

Perhaps the most important extra-departmental undertaking of the year was the volume of maps and charts prepared to illustrate the report on the Plague in India issued by the Home Department. These were 29 in number, and were nearly all either lithographed or photozincographed in colours, 28,000 copies being supplied. For the Revenue and Agricultural Department three maps of India to illustrate Dr. Voelcker's report on the Improvement of Indian Agriculture were lithographed in six colours, and 1,050, copies of each were printed. For the Finance and Commerce Department a diagram showing the course of Exchange and price of Silver in London from January 1892 to December 1897 was lithographed and 450 copies were printed.

For the Director of the Royal Survey Dept., Siam, a map of the Kingdom of Siam and 11 district maps of that country were photozincographed and 230 copies of each supplied. For the Colonial Secretary, Singapore, a map of Penang island and the province of Wellesley, in two sheets, was photozincographed and 500 copies printed off.

A map of India and the Punjab, to illustrate the rail and river-borne trade was lithographed in colours for the Financial Commissioner, Punjab, and 460 copies were supplied; and for the Chief Engineer, Public Works Department, Punjab, a map of the Simla Extension in three sheets, was photozincographed and 300 copies were printed. Thirteen thousand copies of various section papers were reprinted from stone for the Chief Engineer, Irrigation Works, Punjab.

For the Director General of Military Works, maps of the country 12 miles round Ajmere, Deoli, Nusseerabad, Neemuch, Sirdarpore and Mhow were photo-

zincographed, but only that of Mhow was printed off during the year. For the same officer a plan of the Bareilly water-supply scheme was lithographed in seven colours and 150 copies were supplied. Five-mile radius maps of Kohát and Abbottabad, and ten-mile radius maps of Umballa and Meerut were reprinted and copies supplied to the military authorities.

For the Director General of Telegraphs six diagrams pertaining to the telegraphic operations during the Tirah expedition were lithographed and 400 copies of each printed off.

Nine diagrams to illustrate a monograph on cotton fabrics were lithographed for the Director of Land Records and Agriculture, Bengal, and 500 copies of each were printed ; and a map of Chittagong was chromo-lithographed for the same officer, but not printed during the year. For the Director of Land Records and Agriculture, Burma, eight sheets of the Moulmein town survey, on the scale of 400 feet to the inch, were photozincographed, and also a cantonment map of Moulmein.

For the Meteorological Department as usual a very large amount of work was done. Thirty maps and weather charts were reprinted, and 114,146 copies printed off during the year.

For the Archæological Survey of Madras the 62 inscriptions pertaining to the monumental remains of the Dutch East India Company, mentioned in last year's report, were printed off and 30 copies of each supplied. The plates of Part 4 of Mr. E. W. Smith's report on Fatehpur-Síkri were completed during the year ; 59 plates were photozincographed and 650 copies of each printed. The remaining plates were photo-etched.

For the Asiatic Society of Bengal two plates showing the conspectus of text to accompany a report on the Ratnapála Grant were lithographed and 612 copies printed. Plates 1 and 3 of block-type figures from Khotan in Central Asia were photozincographed and 630 copies of each supplied. An old Persian damascened shield was lithographed in bronze and 1,000 copies printed for the Technical Art Series.

Seventy-seven sheets, out of a total of 358 sheets, of the Rangoon town survey, including one index and one reference sheet, were received during the year from the Rangoon Municipality. The index sheet was printed off and blue prints of the others were supplied.

404. The Heliogravure Section was fully occupied during the year on work of the usual kind, chiefly for other departments. Thirteen plates were photo-etched for the Technical Art Series of the year and 1,000 copies printed from each. For the Indian Museum Notes twelve plates were made and 1,025 copies of each printed. As usual, twelve plates illustrating the zoology of the R.I.M.S. *Investigator* were prepared, of which 250 copies were printed of each. Fourteen plates were etched for a catalogue of Echinoderma for the Indian Museum and 500 copies of each printed. For the earthquake report under preparation by Mr. R. D. Oldham, of the Geological Survey, seventeen plates were etched and 1,000 copies of each printed. For the Survey of India report on the total solar eclipse of January 1898 six plates were etched and 200 copies of each printed. The Enamelline half-tone blocks prepared included 37 enlarged impressions of thumb marks, to illustrate a report on the subject of thumb impressions by Mr. E. R. Henry, C. S., Inspector General of Police, Bengal, and 18 views prepared from negatives submitted by the Geological Survey to illustrate the earthquake report.

405. In addition to the regular work of the Heliogravure Section, instruction was imparted to the late Captain E. D. Bullen, R. E., and Mr. J. O'Neill, from the Thomason College, Roorkee, in the processes employed in the section. A considerable amount of useful experimental work was carried on in the section during the year in electro-deposition for correcting hand-engraved plates, and in trichromatic photography, the details of which are given in the Appendix.

406. Mr. Pope, with a small party of assistants, proceeded to Dumráon in Bihar, in January 1898, to obtain photographs of the corona of the total eclipse, with results which were entirely successful. A separate report on this expedition has alreedy been submitted to Government. The three English parties, under the Astronomer Royal, Mr. Stone and Sir Norman Lockyer, respectively, which came to India to make observations of the eclipse, were each

supplied with a photographer from this Office, and with photographic stores and apparatus of various kinds according to their requirements.

407. The scheme for the reorganisation of the Office, referred to in para. 439 of last year's report, which was submitted to Government early in the year, had not, at its close, received the sanction of the Secretary of State for India.*

MAP RECORD AND ISSUE OFFICE.

Personnel.

Mr. A. E. Spring, Officiating Deputy Superintendent, 1st grade, in charge.
„ F. A. D'Rozario, Head Clerk.
„ H R. Vallis, Map-Curator; and 17 other clerks.

408. Mr. A. E. Spring was in charge of this office throughout the year.

409. The number and value of maps issued during the year are as follows:—

Maps issued.	Number.	Value.
		R.
General maps to Government officials	60,768	43,132
Ditto to India Office, London	3,572	4,667
Ditto to private individuals	8,842	11,133
Ditto to agents	1,447	2,244
TOTAL	74,629	61,176
Cadastral maps to Government officials	81,894	56,766
GRAND TOTAL	1,56,523	1,17,942

There has been a considerable reduction in the number and value of maps issued during the year when compared with those of the year preceding: during 1896-97 they were 2,07,330 and R1,57,927, whereas during the year under review they were 1,56,523 and R1,17,942; showing a decrease of 50,807 in number, and R39,985 in value.

The amount realized from cash sales was R19,314, *viz.*, R11,133 from private individuals, R477 from agents, and R7,704 from Government officials; showing a decrease of R5,345 below the cash receipts of the past year.

In the Revenue Section 793 applications were received from private individuals for extracts from original records of the Revenue Surveys, and 2,249 for certified copies of village plans, tracings and traverses, which realized a sum of R7,687.

* Mr. Pope reports that Messrs. Fogarty and Haward, Head Assistants in charge of the Lithographic and Photographic Branches, respectively, have rendered most useful assistance in the management of the Office; that Mr. Turner, Photo-engraver, has as usual worked with zeal and skill, and that Messrs. LeFranc and Vandyke, in charge of the zinc and litho. printing sections, have continued to perform their duties efficiently. Messrs. Deas, McKenzie, Ravenscroft, Michael and DePyvah, in the litho-zinc and type-printing sections, and Messrs. George, Lagnier, Meade, Andrews and Murphy, in the Photographic sections, have all worked satisfactorily. Of the junior assistants, Messrs. Rodrigues, Carville, Vieux, Gonsalves, D'Silva and Francis are also well reported on.

Of the Native staff the following are specially mentioned:—Babus A. C. Mukerjee, Dino Nath Dass, Ashutosh Dass, and Munshis Abdul Mujid, Mohamed Yasin, and Enayetullah, draftsmen; Abdul Rahman, A. C. Bhattacharjee, Preonath, Abdul Ali, Abdul Wadood and Monmotho Nath Sett, assistant photographers. Of the clerical staff, Babu K. L. Sen, head clerk and accountant, has again given entire satisfaction, and Babus K. M. Dass, G. C. Mukerjee, S. K. Banerjee, R. K. Chatterjee, G. P. Pal and N. N. Mookerjee, clerks, have all worked well.

The details of work are specified in the following statement and show a small decrease below last year's figures :—

Details.	Number.
Applications received for maps	3,969
Letters issued in reply	3,190
Cash and credit map sale bills	1,630
Invoices and receipts issued for published maps	2,336
Ditto ditto cadastral maps	169
Ditto ditto extracts from original records	332
Packets, parcels and local despatches	3,687
Ditto received in office	681
Packages despatched by rail and steamer	328
Ditto received ditto	41
Maps coloured for sale and issue	35,141
Ditto for other departments	550

A list of the maps and charts published during the year, copies of which have been stored in this Office, will be found at page 91.*

MATHEMATICAL INSTRUMENT OFFICE.

Personnel.

Lieutenant-Colonel J. R. Hobday, I.S.C., Assistant Surveyor-General in charge, from 1st to 29th April and again from 10th November 1897 to 31st March 1898.
Major F. B. Longe, R.E., Officiating Assistant Surveyor-General, in charge from 30th April to 9th November 1897.

Workshop Branch.

Mr. T. Bolton, Mathematical Instrument Maker.
Mr. T. R. Theakston, Assistant ditto.

Store Branch.

Mr. M. C. Belletty, Instrument Store-keeper.
Babu Woomesh Chunder Chowdhry, Material Store-keeper.

Office Establishment.

Mr. W. Campagnac, Head Clerk.
" W. R. Tulloch, 2nd Clerk.
Six clerks and three temporary clerks.

410. The charge of the office was held by Lieutenant-Colonel J. R. Hobday, I.S.C., from 1st to 29th April and from 10th November 1897 to 31st March 1898, and by Major F. B. Longe, R.E., from 30th April to 9th November 1897.

411. This report refers to the financial year, *i.e.*, from 1st April 1897 to 31st March 1898, and not to the survey year from 1st October to 30th September. During this period the number of serviceable instruments received into store was 54,256 and their value was R2,61,816, whilst the number of those issued from store was 59,100 valued at R2,83,857. In the subjoined statement these figures are compared with those of the preceding year. Owing to the demand for instruments from Railways and other large works there has been an increase both in number and value of instruments issued. There also has been an increase in the value of instruments received, though their number is less.

	1896-97.	1897-98.	Increase.	Decrease.
Number of instruments received	61,558	54,256	...	7,302
Value of ditto in rupees	2,59,405	2,61,816	2,411	...
Number of instruments issued	50,727	59,100	8,373	...
Value of ditto in rupees	2,68,704	2,83,857	15,153	...

* Mr. Spring reports that Mr. D'Rozario has continued to perform his duties to his entire satisfaction. Mr. H. R. Vallis, Map Curator, has as usual rendered excellent service. Messrs. J. A. Vallis, S. A. Hazra and the other assistants have also worked satisfactorily. Mr. Bonnaud, who was transferred as assistant to the Map Curator, has worked well and performed the Map-Curator's duties satisfactorily during Mr. Vallis' absence on privilege leave.

From this table it will be seen that the number of serviceable instruments in store has decreased by 4,844 and their value by R22,041.

412. In the following statement are shown the principal sources from which the serviceable instruments were received :—

SOURCES OF RECEIPT.	Number.		Value.
	1896-97.	1897-98.	
From England on indent	16,046	17,039	81,090
By purchase in the local market	12,117	5,757	36,773
Manufactured in the workshop	7,045	14,374	28,766
Returned to store by public officers	8,865	11,836	9,132
From repairable stock after repair	17,474	5,250	1,06,055
From other sources	11	...	......
TOTAL	61,558	54,256	2,61,816

The number of the instruments received from England on indent has increased by about 993, while their value has decreased by about R11,278. This is mainly due to the fact that no indents for the large expensive instruments such as levels and theodolites have been made for three years, all such instruments having been supplied from the repairable stock, which is being put into serviceable order by the establishments sanctioned for their repair. The value of instruments purchased in India has increased by about R5,099. The number and value of instruments issued has increased by 8,373 in number, and R15,153 in value. The number of instruments manufactured in the workshop has also increased this year owing to the demands on this office from various departments being more this year than the previous one. Their class and value will be found in Table C in the Appendix.

413. The number of instruments taken from the repairable stock and rendered serviceable by the workshop is smaller in number than last year, but their value when repaired is in excess of that of last year. During the year under report, the office has received into store 7,644 repairable instruments valued at R92,059, compared with 20,857 valued at R82,453 in the previous year. The total number of instruments from the repairable stock which were rendered serviceable was 5,250 and their original value was R66,382. These were repaired in the workshop at a cost of R39,673 and transferred at the enhanced value to the serviceable stock. The repairable stock has thus been increased by 2,394 instruments, valued at R25,677. This result is due to large returns of instruments into store by public officers, the number being so large as to defy the best efforts of the workshop to reduce the stock of repairable instruments, although, as shown above, the number and value of the instruments rendered serviceable has considerably increased this year.

414. The conversion of old pattern levels and theodolites, alluded to in para. 446 of last year's report, has been steadily continued, and during the year under report 80 levels of obsolete patterns have been converted into serviceable instruments and issued.

Since the increased establishments for the repair of instruments have been sanctioned as already alluded to in previous reports, 416 levels and 107 theodolites have been converted and issued and all indents for such instruments on England have been discontinued.

415. During the year the number of indents complied with was 1,598, being about 300 more than last year. They were of the usual description and were submitted from all parts of India.

416. The cash payments for charges under R50 amounted to R38,776, being more than the previous year by R7,648.

417. The value of the English indents for the last five years is shown in the following table, which gives some indication of the saving which is being effected by the utilisation of the extra grant for repairing instruments :—

Year.	Value of English Indent.
	£
1894-95	12,981
1895-96	5,208
1896-97	5,079
1897-98	3,995
1898-99	4,823

418. Table A (in the Appendix) shows the amount of debits against various officers and departments for instruments supplied and for work done. It also exhibits the credits for all instruments and materials returned to store. The value of the issues and repairs executed on book debit was R2,57,239, being R9,259 more than last year. This amount includes the value of instruments purchased with the extra departmental grant of R30,000, out of which R29,151 was expended. The credits for instruments returned into store amounted to R1,00,786, which is an increase on the previous year. The grand total of the value of supplies, including the cash sales, is R2,96,015, or about R17,000 more than last year.

419. The total number of instruments of all kinds repaired amounts to 5,106 or about 178 less than last year.

420. The profit and loss account of the workshop will be found in the Appendix, the result of the operations showing a nominal profit of R2,625 from which it appears that the rates for work are fairly correct. A large number of indents were received during the year for instruments such as signalling equipment, range-finders, Scott's sights, clinometers, etc., used by various regiments in the Tirah Expedition. All these demands were efficiently and promptly supplied.*

* The Assistant Surveyor-General reports that Mr. Bolton has conducted the management of the Mathematical Instrument Office with ability, and that he has worked with zeal and energy. Mr. Theakston, his Assistant, has performed his duties efficiently and with thoroughness, and has been well reported on.

In the Correspondence and Store branches, Messrs. Campagnac, Belletty, and Tulloch have given entire satisfaction, and among the native assistants the following are deserving of special mention :—Durga Churn Ghose, Gossain Das Roy, Shib Chunder Ghose, and Narain Chunder Banerji, Clerks; and Woomesh Chunder Chowdhry, Material Store-keeper.

TRIGONOMETRICAL BRANCH OFFICE, DEHRA DÚN.

421. Lieutenant-Colonel St. G. C. Gore, R.E., Superintendent Trigonometrical Surveys, on return from privilege leave, took over charge of the office on the 20th October 1897 from Captain G. P. Lenox-Conyngham, R.E. On 25th April 1898, he proceeded on special leave for six months. During his absence Major S. G. Burrard, R.E., officiated as Superintendent, Trigonometrical Surveys. Mr. J. Eccles, M.A., returned from furlough on the 22nd November 1897, and took over charge of the technical offices of the Trigonometrical Branch from Mr. H. W. Peychers. Lieutenant E. A. Tandy, R.E., on appointment to the department was posted to this office on the 31st January for a course of technical training, and left on the 25th August to join No. 22 Party (Astronomical). Lieutenant A. Mears, I.S. C., was transferred from Nos. 9 and 19 Parties on the 13th April to be put through a course of instruction in astronomical observations, levelling, and the computations of the Trigonometrical Branch. He passed the departmental examination and was confirmed on the 4th August.

Personnel.

Superintendence.

Lieutenant-Colonel St. G. C. Gore, R. E., Superintendent, Trigonometrical Surveys, from 20th October 1897 to 25th April 1898.
Major S. G. Burrard, R.E., Officiating Superintendent, Trigonometrical Surveys, from 26th April 1898.
Mr. J. Eccles, M.A., Superintendent, 2nd grade, in charge Computing Party, from 22nd November 1897.
Captain G. P. Lenox-Conyngham, R.E., Officiating Superintendent, Trigonometrical Surveys, up to 19th October 1897.
Mr. H. W. Peychers, Extra Assistant Superintendent, 1st grade, in charge Computing Party, up to 21st November 1897.

Attached Officers.

Lieutenant E. A. Tandy, R.E., Assistant Superintendent, 2nd grade, from 31st January to 25th August 1898.
Lieutenant A. Mears, S.C., " " 2nd grade, from 13th April 1898.

(1) Computing Section.

Mr. H. W. Peychers, Extra Assistant Superintendent, 1st grade, up to 13th December 1897.
Mr. A. D. L. Christie, " " " 2nd grade.
Babu Amba Prasad and 8 other Computers, 2 Copyists and 2 Writers.

(2) Printing Section.

9 Compositors and 2 Distributors.

(3) Photo-Zincographic Section.

Mr. J. S. Manuel, Zincographer, up to 19th February 1898.
Mr. G. A. LeFranc, Officiating Zincographer.
1 Photographer, 6 Plate correctors, 5 Retouchers, 4 Zinc printers, 12 Assistant Zinc printers, 1 Accountant, 1 Storekeeper, and 1 Despatcher.

(4) Correspondence Section.

Mr. J. Burbridge, Head Clerk, and 3 other clerks.

(5) Stores, Workshops and Observatories Section.

1 Writer, 1 Head Artificer, and 3 Artificers.

(6) Drawing Section.

Mr. C. H. McA'Fee, Extra Assistant Superintendent, 2nd grade.
Mr. J. A. Higgs, " " " 6th "
15 Draftsmen and 1 Surveyor.

(7) Solar Photographic Section.

Mr. R. W. Foster, Assistant Solar Photographer, [*Sub. pro tem.*]

(8) Training School.

Mr. W. A. Fielding, Extra Assistant Superintendent, 6th grade, from 4th November 1897.
Messrs. D. J. Hunter, E. H. Corridon, Babu Dhani Ram, Messrs. W. G. Jarbo, H. R. Hunter and B. M. Berrill, Probationary Sub-Assistant Superintendents.
One Surveyor, 1 Sub-Surveyor and 17 Probationary Sub-Surveyors.

Mr. A. E. Wackrill, A.M.I.C.E., Superintendent of Trigonometrical Surveys, Ceylon, who had joined the office in order to learn the methods of observing and computing, left the office about the middle of November. Mr. H. W. Peychers retired on superannuation pension on the 14th December. Mr. W. A. Fielding, was transferred from No. 18 Party on the 4th November to take charge of the Training school. Mr. J. S. Manuel, Zincographer, retired on invalid gratuity from 19th February, and Babu Umbica Churn Shome retired on superannuation pension on the 2nd July.

The office is divided into the following sections :—

(1) Computing.
(2) Printing.
(3) Photozincographic.
(4) Correspondence.
(5) Stores, Workshops and Observatories.
(6) Drawing.
(7) Solar Photographic.
(8) Training School.

(1) Computing Section.

422. Seven instalments of field records were received during the year and stored as usual. In all 19 requisitions for data and 49 indents for forms were complied with. A revision of the heights of the principal and secondary stations of the Biláspur Meridional Series, necessitated owing to sensible discrepancies being disclosed by the extension of the lines of spirit-levelling, was begun. A reduction of the observations of a new net work triangulation of the country round Dehra for the training school was completed. A table for determining heights in traversing was prepared. A considerable amount of work, still progressing, is involved in the reduction of the observations by Captain Deasy in his explorations in Tibet. Two triangulation charts of Burma and Assam were compared and examined, and four of the Great Arc Meridional Series, Section 8° to 18°, and two of the Indus Delta Triangulation are in hand. The meteorological and magnetic observations were continued as usual.

(2) Printing Section.

423. The following is the progress made :—

(*a*) Tidal Volume, 16 pages printed.
(*b*) Synoptical Volumes of the Great Arc Meridional Series, Section 8° to 18°, and Indus Delta Triangulation, 80 pages printed.
(*c*) The Solar Eclipse Report, 16 pages printed.

In addition to the above, a large amount of work was done in printing the letter-press for charts, headings and foot-notes for maps, and 64,000 copies of professional and other forms were printed.

(3) Photo-zincographic Section.

424. The entire work of the section devolved on the Assistant Zincographer since the retirement of Mr. Manuel. The usual routine of map publication was carried on, and no arrears remain.

(4) Correspondence Section.

425. This has been conducted as usual.

(5) Stores, Workshops and Observatories Section.

426. An astronomical equipment for the Solar Eclipse Camp at Sahdol was prepared and despatched. The work in the observatories was done as usual.

(6) Drawing Section.

427. As the mapping of No. 18 Party was very much in arrears, assistance was rendered by this section in preparing the 4-inch sheets for reduction to half scale, and in extracting the *mauza* areas from four of the 4-inch sheets. The outturn will be found fully detailed in the appendix.

(7) Solar Photographic Section.

428. The work of this section was conducted as usual ; experiments with dry plates were continued and fairly successful results were obtained. The 12-inch instrument was also put in working order.

(8) *Training School.*

429. The Training School, under Mr. W. A. Fielding, imparted instruction in theodolite traversing, triangulation, levelling and plane-tabling, also fair mapping, projection, plotting, and the computations of the topographical branch. The six new Probationary Sub-Assistant Superintendents and 17 Apprentice Sub-Surveyors were passed through the School. Besides these, instruction in practical plane-tabling was given to Lieutenants Tandy and Mears and to four recorders of No. 24 Party, and in levelling to one Sub-Surveyor of No. 18 Party.

The offices were inspected by the Surveyor-General in April and July, and he was quite satisfied with the working of the several sections.*

III.—DRAWING OFFICE, SIMLA.

430. Mr. Atkinson held charge of the Simla Drawing Office till the return of Lieutenant-Colonel Wahab from field service on the 13th April 1898, and again held charge during that officer's absence at Quetta from the 5th to the 30th May 1898. Mr. Atkinson, besides holding charge of the office for about seven months of the year, has taken a large share in the actual mapping. He retires within the next few days after a service of over 39 years, during a great part of which he has been employed on the compilation of the maps of the Indian frontier and surrounding countries. His long experience and intimate knowledge of the geography of Central Asia have been of great value to the office, the superintendence of which has devolved on him for long periods during the absence of the Superintendent in the field.

Personnel.

Lieutenant-Colonel R. A. Wahab, C.I.E., R.E., Officiating Superintendent, 1st grade.
Mr. G W. E. Atkinson, Officiating Deputy Superintendent, 1st grade.
Mr. W. J. Cornelius, Extra Assistant Superintendent, 4th grade.
Mr. R. R. Dickinson, " " 5th grade.
Mr. F. E. Warde, Sub-Assistant Superintendent, 2nd grade.
Mr. F. Rozario, Surveyor.
Mr. H. Sindon, Draftsman.
Munshi Noor Baksh, "
and four other draftsmen and one writer.

431. The office was inspected by the Surveyor-General in July.†

IV.—FOREST SURVEY BRANCH OFFICE, DEHRA DÚN.

432. Mr. W. H. Reynolds, Superintendent, Forest Surveys, was in charge of the head-quarters offices of the Forest Survey Branch throughout the year. The following branches of work were dealt with:—

(i) Correspondence and accounts of the several provincial forest survey detachments.
(ii) Computations and areas of the several field detachments.
(iii) Up-keep of the Forest Department map records of the several provinces under the Government of India.
(iv) Compilation and drawing of special maps for the Forest Department.
(v) Training of surveyors.
(vi) Other miscellaneous work for the Forest Department.

433. The up-keep of the map records of the forests in the several provinces under the Government of India, as well as Madras, have been posted up

* Mr. Eccles reports very highly of the work done by his assistants, Messrs. Christie, McA'Fee Higgs, Le Franc and Foster, and speaks well of the computers, draftsmen, accountant, and the head writer of the Computing Section.

The Superintendent reports very favourably of the assistance rendered him by Messrs. Christie and McA'Fee; also of the services rendered by Mr. J. Burbridge, the Head Clerk, and Babu Hira Singh, the Second Clerk of his office.

The Superintendent expresses his satisfaction with the work done by Mr. Fielding and Munshis Muhammad Zakaria and Zakiruddin, Instructors of the training school.

† The officer in charge reports favourably on the continued zeal and good character of work of Mr. Cornelius, and on Messrs. Dickinson and Warde as painstaking and diligent assistants. Of the draftsmen it is said that they have all worked well, Messrs. H Sindon, Rozario, and Noor Baksh being specially mentioned. Writer Ganga Ram is also specially mentioned.

from time, to time, and all new tracts gazetted as State forests have been located on existing maps. This branch of the work was unusually heavy during the year under report, more particularly for Madras and the Central Provinces.

434. During the year, 29 maps on various scales for special purposes have been published, 31 are in the press, and 24 are in different stages of progress. Of the 4-inch standard sheets of the reserved forest areas surveyed by the Forest Survey Branch, 92 sheets were published, 131 are in the press, and 168 sheets are in progress and well advanced towards completion. Of the 1-inch standard sheets of the Punjab, one sheet has been published, one is in the press, and, nine are in progress.

435. In the way of miscellaneous work, 2,156 printed maps of various sorts were coloured, and 350 tracings were prepared for various Forest and District officers; information regarding the distribution of forests was added to 20 printed maps and 1,512 printed sheets were cut up and mounted in book form for the use of Forest and other officials.

436. During the year 29 new men were instructed in the use of the plane-table, 3 were taught theodolite traversing, and two men learnt the use of the spirit level.

Mr. Reynolds reports that Mr. Descubes has, as usual, conducted his duties in a highly satisfactory manner and spared no personal trouble to push on his work; he is a most valuable assistant. Mr. Watson is also mentioned as having performed his duties with zeal and ability.

Of the native establishment, the following are specially brought to notice:—Babus Kali Kanth Kar, Lalit Mohan Basak, Tulsi Ram, and Mohamed Hossain.

LIST OF MAPS AND CHARTS PUBLISHED AT CALCUTTA DURING THE YEAR 1897-98.

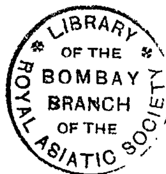
TITLE.	Scale.	Number of sheets.	REMARKS.
	In. M.		
ATLAS OF INDIA.			
Sheet No. 88	1=4	1	With additions to 1896.
Sheet No. 89	1=4	1	With additions to 1898.
Sheets Nos. 94 and 118	1=4	2	With additions to 1897.
Sheet No. 106	1=4	1	With additions and corrections to December 1893.
Sheets Nos. 1 N. E., 3 N. E., 11 N. E., 11 N. W., 35 N. E., 36 N. E., 67 S. E., and 67 S. W.	1=4	8	With additions to 1895.
Sheet No. 52 N. W.	1=4	1	With additions to 1891.
Sheets Nos. 31 N. W., 31 S. E., 39 S. E., 49 N. E., 52 N. E. 52 S. E., 66 S. E., and 129 N. E.	1=4	8	With additions to 1896.
Sheet No. 69 N. W.	1=4	1	With additions to 1894.
Sheet No. 71 N. E.	1=4	1	With additions to 1888.
Sheet No. 71 S. E.	1=4	1	With additions to May 1897.
Sheet No. 127 N. W.	1=4	1	With additions to January 1897.
Sheets Nos. 37 N. E., 87 N. W., and 91 S. E.	1=4	3	With additions to 1892.
Sheet No. 127 S. E.	1=4	1	With additions to 1887.
Sheets Nos. 24 N. E., 26 S. E., 48 S. W., 61 S. E., 77 S. E., and 89 S. E.	1=4	6	
Sheet No. 90 N. W.	1=4	1	With additions to 1898.
Sheet No. 95 N. W.	1=4	1	With additions to 1889.
Sheets Nos. 124 N. E. and 124 S. E.	1=4	2	With additions to 1893.
GENERAL MAPS.			
India (with hills)	1=128	1	With additions to railways to 1897.
Persia (1897)	1=16	6	
PROVINCIAL MAPS.			
Bengal, Bihar, Orissa and Chota Nágpur (skeleton)	1=16	2	
Bengal, Bihar, Orissa and Chota Nágpur (with hills)	1=32	1	
Gujarát (with hills)	1=16	1	
Mysore and Coorg	1=16	1	
Punjab and surrounding countries (skeleton)	1=32	1	

Title.	Scale.	Number of sheets.	Remarks.
District Maps.	In. M.		
Backergunge	1=4	1	With additions and corrections to March 1896.
Darjeeling (with hills)	1=4	1	
Nadia	1=4	1	With additions and corrections to May 1898.
Pabna (skeleton)	1=4	1	With additions to 1897.
Rájsháhi	1=4	1	With additions and corrections to 1897.
Simla with adjoining Native States	1=4	1	
Standard Maps.			
Bengal.			
Sheet No. 125	1=1	1	With additions to 1892.
Sheet No. 126	1=1	1	With additions to railways to 1896.
Bombay.			
Sheets Nos. 199 N.E. and 199 S.E.	2=1	2	With corrections to names to October 1897.
Sheet No. 192	1=1	1	With additions to forest boundaries and canals to May 1897.
Burma (Lower).			
Hanthawaddy District—Sheets Nos. 232 $\frac{N.E.}{2}$; 232 $\frac{N.E.}{4}$ and 280 $\frac{N.W.}{1}$	4=1	3	
Pegu District—Sheet No. 279 $\frac{N.W.}{2}$	4=1	1	
Hanthawaddy and Pegu Districts—Sheet No. 278 $\frac{N.W.}{4}$	4=1	1	
Sheets Nos. 281 and 282	1=1	2	With corrections to September 1897.
Sheet No. 371	1=1	1	Preliminary edition.
Sheet No. 374	1=1	1	2nd edition.
Sheets Nos. 476 and 477	1=1	2	
Burma (Upper).			
Sheets Nos. 89, 90, 130 and 314	1=1	4	
Sheets Nos. 260 and 359	1=1	2	Preliminary edition.
Sheet No. 306	1=1	1	2nd edition.
Central India and Rájputána.			
Sheets Nos. 213, 441 and 459	1=1	3	
Sheet No. 252	1=1	1	With corrections to 1895.
Sheet No. 304	1=1	1	With additions to railways to 1896.
Sheet No. 312	1=1	1	With additions to June 1897.
Sheet No. 381	1=1	1	With additions to 1894.
Sheets Nos. 159, 160, 192 and 193 (in one)	1=2	1	With corrections to boundaries to November 1896.
Sheets Nos. 161, 162, 194 and 195 (in one)	1=2	1	With additions to railways to 1896.

Title.	Scale.	Number of sheets.	Remarks.
STANDARD MAPS—*continued*.			
Central Provinces.	In. M.		
Betúl District—Sheets Nos. $27\frac{N.W.}{1}$; $27\frac{S.W.}{1}$ and $27\frac{S.W.}{2}$ (in one); $28\frac{N.W.}{3}$; $36\frac{N.W.}{1}$ and $25\frac{N.E.}{2}$ (in one); $36\frac{N.W.}{2}$; $36\frac{N.W.}{3}$; $36\frac{N.W.}{4}$; $36\frac{S.E.}{2}$ and $36\frac{S.E.}{4}$ (in one); $36\frac{N.E.}{3}$; and $37\frac{N.W.}{1}$	4=1	10	
Biláspur District—Sheet No. $180\frac{N.W.}{4}$	4=1	1	
Damoh District—Sheets Nos. $61\frac{S.E.}{2}$; $61\frac{S.E.}{4}$; $62\frac{N.E.}{2}$; $62\frac{N.E.}{3}$; $62\frac{N.E.}{4}$; $62\frac{S.E.}{1}$; $62\frac{S.E.}{2}$ and $62\frac{S.E.}{3}$ (in one) $63\frac{N.W.}{4}$; $63\frac{S.E.}{4}$; $64\frac{S.E.}{1}$; $64\frac{S.E.}{2}$; $64\frac{S.E.}{3}$; $64\frac{S.E.}{4}$; $64\frac{N.E.}{1}$; $64\frac{N.E.}{2}$; $64\frac{N.E.}{3}$; $64\frac{N.E.}{4}$; $65\frac{N.E.}{1}$; $65\frac{N.E.}{2}$; $65\frac{N.E.}{3}$; $65\frac{N.E.}{4}$; $65\frac{N.W.}{2}$ and $65\frac{N.W.}{4}$ (in one); $65\frac{S.E.}{2}$; $65\frac{S.E.}{3}$; $65\frac{S.E.}{4}$; $65\frac{S.W.}{2}$ and $65\frac{S.E.}{1}$ (in one); $65\frac{S.W.}{4}$ and $66\frac{N.W.}{2}$ (in one); $66\frac{N.E.}{1}$ $66\frac{N.E.}{2}$; $66\frac{N.E.}{3}$; $66\frac{N.E.}{4}$; $81\frac{N.W.}{1}$ and $81\frac{N.W.}{3}$ (in one); $81\frac{N.W.}{4}$; $81\frac{S.W.}{1}$; $81\frac{S.W.}{2}$; $81\frac{S.W.}{3}$; $82\frac{S.E.}{3}$ and $83\frac{S.E.}{4}$ (in one); $83\frac{N.E.}{1}$; $83\frac{N.E.}{2}$; $83\frac{N.E.}{3}$; $83\frac{N.E.}{4}$; $83\frac{N.W.}{2}$; $83\frac{N.W.}{4}$; $83\frac{S.E.}{1}$; $83\frac{S.E.}{3}$; $83\frac{S.E.}{4}$ and $83\frac{S.E.}{2}$ (in one); $83\frac{S.W.}{3}$; $83\frac{S.W.}{2}$ and $83\frac{S.W.}{4}$ (in one); $84\frac{N.E.}{1}$; $84\frac{N.E.}{2}$; $84\frac{N.E.}{3}$; $84\frac{N.E.}{4}$; $84\frac{N.W.}{3}$; $84\frac{S.E.}{1}$; $84\frac{S.E.}{2}$; $84\frac{S.E.}{3}$; $84\frac{S.W.}{1}$; $84\frac{S.W.}{3}$; $84\frac{S.W.}{4}$; $84\frac{S.W.}{2}$ and $84\frac{N.W.}{4}$ (in one); $85\frac{N.E.}{1}$; $85\frac{N.E.}{3}$; $85\frac{N.W.}{1}$; $85\frac{N.W.}{2}$; $85\frac{N.W.}{3}$; $85\frac{N.W.}{4}$; $85\frac{S.W.}{1}$; $85\frac{S.W.}{2}$ and $85\frac{S.E.}{1}$ (in one); $85\frac{S.W.}{3}$; $85\frac{S.W.}{4}$; and $86\frac{N.W.}{1}$.	4=1	71	
Hoshangabad and Betúl Districts—Sheet No. $35\frac{S.W.}{1}$.	4=1	1	
Nimár District—Sheet No. $8\frac{N.E.}{4}$	4=1	1	With corrections to boundaries to 1897.
Sheets Nos. 35 and 50	1=1	2	
Hyderabad.			
Sheet No. 168	1=4	1	
North-Western Provinces and Oudh.			
Sheet No. 13	1=1	1	With additions to roads and canals to July 1897.
Punjab.			
Kángra District—Sheets Nos. $264\frac{N.E.}{2}$ and $264\frac{S.W.}{3}$.	4=1	2	
Patiála State Forests—Sheets Nos. $312\frac{N.W.}{1}$; $312\frac{N.W.}{2}$; $312\frac{N.W.}{4}$ and $312\frac{N.E.}{1}$	4=1	4	
Sirmúr State Forests—Sheets Nos. $314\frac{N.E.}{2}$ and $336\frac{N.W.}{2}$ (in one); $336\frac{N.W.}{1}$; $336\frac{N.W.}{3}$ and $336\frac{N.W.}{4}$.	4=1	4	
Umballa District and Simla Hill States—Sheet No. $313\frac{N.W.}{2}$	4=1	1	

Title.	Scale.	Number of sheets.	Remarks.
STANDARD MAPS—*concluded.*			
Punjab—concluded.	In. M.		
Kángra District—Sheet No. 265 N.W.	2=1	1	
Kángra and Hoshiárpur Districts—Sheets Nos. 265 S.E. and 265 S.W.	2=1	2	
Kángra District and Mandi State—Sheet No. 285 S.W.	2=1	1	
Simla Hill and Suket States—Sheet No. 311 N E.	2=1	1	
Sheet No. 260	1=1	1	With corrections to 1895.
Sind.			
Sheets Nos. 1 and 2 (in one) 15, 16, 17, 66, 67, 87, and 88	1=1	8	
North-Eastern Frontier Series.			
Sheet No. $\frac{5-12}{6-13}$	1=16	1	
South-Eastern Frontier Series.			
Sheet No. 1 N.E.	1=4	1	6th edition. With additions and corrections to 1896.
Sheet No. 1 N.W.	1=4	1	4th edition. With additions to May 1898.
Sheet No. 5 N.W.	1=4	1	5th edition. With additions to 1898.
PLANS OF CITIES AND CANTONMENTS.			
Calcutta, Sheets Nos. P24 and N17	1=50 ft.	2	2nd edition.
Karáchi City (Layári Quarter) with Index Sheets, 1 to 18	1=80	18	
Sipri	1=500 ft.	1	With additions to 1898.
Mussooree and Landour Guide Map	8=1M.	1	Corrected to 1896.
Mooltan and environs (1894-95)	6=1	8	
Simla and Jutogh	6=1	1	3rd edition. (Revised and corrected to 1897.
ADMINISTRATION REPORT MAPS.			
Bhandára, Bogra, Burdwan, Cuttack, Dacca, Darbhanga, Delhi, Hazáribágh, Hissar, Karnál, Lahore, Ludhiána, Monghyr, Montgomery, Nágpur, Peshâwar, Rájsháhi, Saugor, Sonthál Parganás, and Wardha	1=8	20	
Bálághát	1=12	1	
Bilåspur, Chánda, Dehra Ismáil Khán, and Ferozepore	1=16	4	
INDEX MAPS.			
To the standard sheets of the Punjab	...	1	Corrected to 1898.
To Sheet No. 1 of the standard sheets of Sind (Bombay Presidency)	...	1	With additions and corrections to 1897.
STATISTICAL MAPS.			
India, shewing Railways	1=80	1	Corrected to 31st March 1898.
MISCELLANEOUS.			
Pyinma Forest Reserve, part of sheet Nos. 278 $\frac{S.W.}{1}$ and 278 $\frac{S.E.}{1}$ (Pegu District, Lower Burma)	4=1	2	

Title.	Scale.	Number of sheets.	Remarks.
MISCELLANEOUS—*concluded.*	In. M.		
Nos. 43B. and 128, Airala and Putramaddi reserved forests, Chittoor Táluk, North Arcot District, Madras	4=1	1	
No. 45, Matárakadapa reserved forest, Tiruppattúr Táluk, Salem District, Madras	4=1	1	
No. 49, Ammur reserved forest; Wálájápet Táluk; North Arcot District, Madras	4=1	1	
No. 68, Kelur reserved forest, Polur Táluk; North Arcot District, Madras	4=1	1	
Nos. 76 & 84, Naikaneri Extension and Charagallu reserved forests, Gudiyáttam and Palmanér Táluks, North Arcot District, Madras	4=1	2	
No. 77, Morthana Extension reserved forest, Gudiyáttam Táluk, North Arcot District, Madras	4=1	1	
No. 85, Pednaigdrug reserved forest, Palmanér Táluk; North Arcot District, Madras	4=1	2	
No. 92, Gundalapalle reserved forest; Gudiyáttam Táluk; North Arcot District, Madras	4=1	1	
No. 93, Pallelakuppam reserved forest, Gudiyáttam Táluk; North Arcot District, Madras	4=1	1	
No. 96A, Tavanampalle reserved forest, Chittoor Táluk; North Arcot District, Madras	4=1	1	
No. 102, Mel Mayi reserved forest, Palmanér Táluk; North Arcot District, Madras	4=1	1	
No. 107, Palmanér reserved forest, Palmanér Táluk; North Arcot District, Madras	4=1	1	
Nos. 115 & 135, Zangalapalle and Gundalapalle extension reserved forests, Palmanér and Gudiyáttam Táluks; North Arcot District, Madras	4=1	1	
No. 116. Pattikonda reserved forest, Palmanér Táluk; North Arcot District, Madras	4=1	1	
No. 125B., Parappu Malai reserved forest, Chittoor Táluk; North Arcot District, Madras	4=1	1	
No. 132, Pallelakuppam extension reserved forest, Gudiyáttam Táluk; North Arcot District, Madras	4=1	1	
Nos. 133A and 133B Kempasamudram reserved forests Gudiyáttam Táluk; North Arcot District, Madras	4=1	1	
No. 162, Pápanayakanhalli reserved forest, Dharmapuri and Krishnagiri Táluks; Salem District, Madras	4=1	1	
Hosúr and Dharmapuri Táluks, reserved forests, sheets Nos. 13, 15, 17, 19, 20, 21, 22, 23, 24 and 26, Madras	4=1	10	
Totakanáma reserved forest, Palmanér Táluk; North Arcot District, Madras	4=1	1	
Virlabanda and Nellipatla reserved forests, Palmanér Táluk; North Arcot District, Madras	4=1	2	
Plan of the camp at Sahdol (Central India) for the total eclipse of the sun, on 22nd January 1898	24=1	1	
The Kháibar Pass (1898)	2=1	1	
The Karenni boundaries	1=4	1	
Tenasserim and adjacent provinces of the Kingdom of Siam	1=4	6	With additions to boundaries to October 1897.
Part of the North-West Frontier	1=16	1	
CHARTS.			
Central Provinces. Sheets Nos. 61 and 85, seasons 1894-96.	1=2	2	
Gujarát Survey. Degree Sheet No. X, seasons 1874-75, 1879-81 and 1891-92	1=4	1	
Madras Forest, Sheets Nos. 1, 2 and 3, District Madura (1866-93)	1=2	3	
Sind Survey, Sheet No. 17	1=2	1	



LIST OF MAPS PUBLISHED AT DEHRA FOR THE FOREST SURVEY BRANCH DURING 1897-98.

Title of Map.	Scale.	Number of sheets.
STANDARD MAPS.	In. M.	
Burma.		
Pyinmana Forest Survey.		
Sheets Nos. 222 $\frac{\text{N. E.}}{3}$, $\frac{\text{S. E.}}{1}$, $\frac{\text{S. E.}}{3}$; 270 $\frac{\text{N. W.}}{1}$, $\frac{\text{N. W.}}{2}$, $\frac{\text{N. W.}}{3}$ and $\frac{\text{N. W.}}{4}$.	4=1	7
Salween-Ataran Forest Survey.		
Sheet No. 551 $\frac{\text{N. E.}}{1}$	4=1	1
Central Provinces.		
Bálághát Forest Survey.		
Sheets Nos. 90 $\frac{\text{S. E.}}{2 \& 4}$; 91 $\frac{\text{N. E.}}{4}$; 111 $\frac{\text{S. W.}}{2}$, $\frac{\text{S. W.}}{4}$, $\frac{\text{S. E.}}{1 \& 2}$, $\frac{\text{S. E.}}{3}$, $\frac{\text{S. E.}}{4}$; 112 $\frac{\text{N. W.}}{1 \& 3}$, $\frac{\text{N. W.}}{4}$; 112 $\frac{\text{N. E.}}{1}$; 112 $\frac{\text{S. W.}}{1}$, $\frac{\text{S. W.}}{2}$, $\frac{\text{S. W.}}{3}$, $\frac{\text{S. W.}}{4}$; 113 $\frac{\text{N. W.}}{2}$; 136 $\frac{\text{N. W.}}{1}$ and part of 135 $\frac{\text{S. W.}}{3}$; 136 $\frac{\text{N. W.}}{2}$; $\frac{\text{S. W.}}{2}$; 137 $\frac{\text{N. W.}}{1}$ and $\frac{\text{N. W.}}{2}$.	4=1	20
Bhandára Forest Survey.		
Sheets Nos. 95 $\frac{\text{S. E.}}{2}$, $\frac{\text{S. E.}}{4}$; 117 $\frac{\text{N. W.}}{1}$, $\frac{\text{S. W.}}{1}$, $\frac{\text{S. W.}}{3}$ and 118 $\frac{\text{N. W.}}{1 \& 3}$	4=1	6
Chhindwára Forest Survey.		
Sheets Nos. 70 $\frac{\text{S. E.}}{1}$ and $\frac{\text{S. W.}}{2}$, $\frac{\text{S. E.}}{3}$ and part of $\frac{\text{S. W.}}{4}$, $\frac{\text{S. E.}}{4}$, $\frac{\text{S. W.}}{3 \& 4}$; 71 $\frac{\text{N. W.}}{3 \& 4}$, $\frac{\text{N. E.}}{1}$, $\frac{\text{N. E.}}{3}$, $\frac{\text{S. E.}}{1}$, $\frac{\text{S. E.}}{3}$; 72 $\frac{\text{N. W.}}{2}$, $\frac{\text{N. W.}}{4}$ and $\frac{\text{N. E.}}{1 \& 3}$.	4=1	12
Narsinghpur Forest Survey.		
Sheets Nos. 47 $\frac{\text{S. E.}}{4}$; 48 $\frac{\text{N. E.}}{4}$; 66 $\frac{\text{N. W.}}{1}$, $\frac{\text{N. W.}}{4}$, $\frac{\text{N. W.}}{3}$ and $\frac{\text{S. E.}}{1}$.	4=1	6
Nágpur-Wardha Forest Survey.		
Sheets Nos. 72 $\frac{\text{N. W.}}{4}$, $\frac{\text{N. E.}}{1}$, $\frac{\text{N. E.}}{3}$, $\frac{\text{N. E.}}{4}$, $\frac{\text{S. W.}}{2}$, $\frac{\text{S. W.}}{3}$, $\frac{\text{S. W.}}{4}$, $\frac{\text{S. E.}}{1}$, $\frac{\text{S. E.}}{2}$, $\frac{\text{S. E.}}{3}$, $\frac{\text{S. E.}}{4}$; 73 $\frac{\text{N. E.}}{1}$; 92 $\frac{\text{N. W.}}{3}$, $\frac{\text{. W.}}{}$ and $\frac{\text{S. W.}}{3}$	4=1	15
Ráipur Forest Survey.		
Sheets Nos. 205 $\frac{\text{S. W.}}{4}$; 206 $\frac{\text{N. W.}}{2}$, $\frac{\text{N. W.}}{4}$, and $\frac{\text{S. W.}}{2}$	4=1	4
Saugor Forest Survey.		
Sheets Nos. 47 $\frac{\text{S. W.}}{2}$; 65 $\frac{\text{N. W.}}{4}$, $\frac{\text{S. W.}}{2}$, $\frac{\text{S. W.}}{4}$, $\frac{\text{S. E.}}{1}$, $\frac{\text{S. E.}}{3}$; 66 $\frac{\text{N. W.}}{1}$, $\frac{\text{N. W.}}{2}$ and $\frac{\text{N. W.}}{4}$	4=1	9
Seoni Forest Survey.		
Sheet No. 92 $\frac{\text{S. W.}}{1}$	4=1	1

Title of Map.	Scale.	Number of sheets.
STANDARD MAPS—(contd.)		
NORTH-WESTERN PROVINCES AND OUDH.	In. M.	
Gonda Forest Survey.		
Sheets Nos. 158 $\frac{S.W.}{2 \& 4}$, $\frac{S.E.}{3}$; 159 $\frac{N.E.}{1}$, $\frac{N.E.}{2}$ and part of 171 $\frac{S.W.}{3}$; 172 $\frac{N.W.}{1}$ and $\frac{N.W.}{4}$	4=1	6
Lalitpur Forest Survey.		
Sheet No. 60 $\frac{N.W.}{3}$ and part of 60 $\frac{N.W.}{1}$	4=1	1
PUNJAB.		
Bashahr Forest Survey.		
Sheet No. 346	1=1	1
Index Maps.		
Index showing progress of Forest Surveys in the Central Provinces . . .	1=32	1
„ to the Forest Surveys in the Pyinmana District	1=8	1
„ „ „ „ „ Ruby Mines Division, Burma	1=8	1
„ „ „ „ „ Salween-Ataran Division, Burma . . .	1=32	1
„ „ „ „ „ Chamba State	1=8	1
„ „ „ „ „ Bilâspur District	1=12	1
„ „ „ „ „ Goâlpâra District Assam Working Plan . .	1=2	1
Miscellaneous.		
Kullu District, Inner Seorâj Range	1=2	1
„ „ Wazîri Rupi Range	1=2	1
„ „ Outer Seorâj Range	1=2	1
„ „ Kullu Proper Range	1=2	1
Pyinmana Division, Lewe Range, Yeni Reserve, Yeni Working Circle . . .	1=1	1
Hyderabad Assigned Districts or Berar, Akola District, Khâmgaon Tâluk . .	1=1	1
„ „ „ „ „ Jalgaon Tâluk . .	1=1	1
„ „ „ „ „ Bâlapur Tâluk . .	1=1	2
Coorg Forests, Devammachi-Mawukal Forest Reserve	2=1	1
Sketch of the leased Chir Forests Tehri Garhwâl	2=1	1
Nepâl-Kheri Boundary (on the Mohan River)	1=1	1
„ „ „ „ showing the give and take areas .	1=1	1
Sketch Map of the Melghât Tâluk, Ellichpur, Berar	1=4	1
Eusemble d'un appareil distillatoire No. 1	...	1
Eusemble d'un distillerie d'essence de terrebenthine No. 2	...	1
Municipal Forests, Simla, 1897	8=1	1

APPENDIX.

EXTRACTS

FROM

REPORTS BY EXECUTIVE OFFICERS.

Narrative report by MAJOR F. B. LONGE, R.E., *Superintendent, 2nd grade, on the Survey operations with the Burma-China Boundary Commission, Southern Section, season 1897-98.*

Introductory.—In 1894 a "Convention" between Great Britain and China was signed on the 1st March, defining amongst other things the boundary between Burma and Yunnan; owing, however, to the failure of the Chinese Government to abide by its stipulations, certain modifications became necessary, and, in consequence, further negotiations were commenced towards the end of 1895, which resulted in what is termed the "Agreement," a document signed in Pekin on the 4th February 1897, which, while modifying the boundary between the two countries, did not otherwise differ very materially from the previous convention. The original "Convention" was never annulled, but is constantly referred to in the "Agreement," consequently the two documents have to be read together, a fact which led to a vast amount of trouble and argument in the field, and in a great measure contributed to the failure of the Southern party to carry out the work entrusted to it.

There were also, as will be seen later on, mistranslations of the English text in the version supplied to the Chinese Commissioners and no proper orders had apparently been issued to the Commission by the Tsung-li Yamen. Thus while the British sections had definite orders and fairly accurate maps of the country, maps which at any rate clearly showed the intention of the wording of the articles of the "Agreement," the Chinese Commission appeared to be endeavouring not to lay down the boundary as defined by the two Governments, but to discover on the spot some imaginary boundary formerly existent between the two countries. Differences of opinion thus arose at the outset.

Constitution of the Commission.—The composition of the Commission (British Section) was as follows :—

Mr. H. Thirkell White, C.I.E., Commissioner.
" E. C. S. George, C.I.E., Sub-Commissioner.
" W. Warry, Chinese Adviser.
" P. F. Hausser, Consul at Momein.
Major F. B. Longe, R.E., } Survey Officers.
Captain T. F. B. Renny-Tailyour, R.E., }
Lieutenant W. K. Scharlieb, } Commanding the Escorts,
Lieutenant J. F. W. Ffrench-Mullen, and }
Captain E. W. M. Norie, Middlesex Regiment, Intelligence Officer.

The Chinese Commission consisted of :—

General Liu Wan Sheng . . . Commissioner.
P'eng Chi Chih, Magistrate of Chan-i }
Yang Chun, Sub-Prefect of Long-Ling, } Sub-Commissioners.
Chen-li-ta, Magistrate of Milo, }

with a number of other officers, Military and Civil, and some so-called Surveyors.

The Survey portion of the Commission was divided into two sections as follows :—

Northern Section.—Captain Renny-Tailyour, R.E., in charge.
Mahmud Hussain and Abdul Rahim, Surveyors, with 34 *tindals* and *khalásis*.

NOTE.—Only those articles which differ from the similarly numbered articles of the "Convention" are given *in extenso* in the "Agreement," the numbers of the other articles and a reference to the Convention only being given.

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Southern Section.—Major F. B. Longe, R.E. in charge.
Ikbaluddin, Sub-Assistant Superintendent.
Lachman Jadu, Surveyor, and a similar number of *khalásis*.

Preliminary work.—An estimate showing the initial, final and monthly recurring cost of two parties of this strength was submitted to and received the sanction of the Government of India, and the assistants and *khalásis* were selected from Nos. 21 and 11 Parties, then recessing at Bangalore. Their instrumental equipment was also mainly taken from the stores of those parties, but tents were purchased from the Elgin Mills.

As the G. T. Triangulation (Irrawaddy series) only extended as far north as Katha and the Shan States secondary series as far as the Salween river, it was considered advisable, in order to render the work as final and accurate as possible, to detail special triangulators to carry these two series, to points on or near the frontier, to allow of the surveys being started from accurate bases, and to carry this out, Mr. P. J. Serrao of No. 10 Party was sent on ahead to continue the Mandalay series northwards and Mr. H. G. Shaw of No. 11 Party to produce the Shan States secondary series eastwards to the frontier.

It was arranged that rations for the *khalásis* and private followers should be supplied by the military police, and mule transport (Panthay mules) was obtained through the Deputy Commissioner of Bhamo at the comparatively cheap rate of R12-3 per mule per mensem.

Concentration of Parties.—I left Calcutta by the British India Steam Navigation Company's ship *Lindula* on the morning of the 19th November 1897, and arrived at Rangoon on the evening of the 22nd. The 23rd and 24th were spent making arrangements with the Burma Secretariat, etc., in conjunction with Captain Renny-Tailyour, and on the 26th Mr. Thirkell White having come to Rangoon from Mandalay, I went with him to the Secretariat for final instructions and left the same night with Captain Renny-Tailyour for Mandalay.

While in Rangoon, I arranged with Lieutenant Hare, at the request of the Lieutenant-Governor, for the despatch of Natha Singh with a Civil Officer, to demarcate the boundary between the Chin Hills and Upper Chindwin district.

Captain Renny-Tailyour and I remained at Mandalay until the morning of the 30th November when we sailed in the Irrawaddy Flotilla Company's boat *Mogaung* for Bhamo, arriving there on December 2nd. On arrival there certain re-arrangements had to be effected; our surveyors were out clearing distant peaks and some had to be recalled, others had to be sent with escorts to clear minor hills, and we were fully employed till 17th and 18th December, when we finally left for the frontier.

Meeting of the Commissions at Bhamo.—On the 6th December the Commissioner, accompanied by Messrs. Warry and Hausser, arrived at Bhamo from Rangoon, Mr. George had already come down from Myitkyina, and everything was ready with the exception of the mule transport which had not arrived.

On the 8th, the Chinese Commissioner arrived and was suitably housed in one of the Missionary bungalows, the owner being away in the district; he was given a salute of 11 guns by the mountain battery stationed in the Fort, and on the 9th at 1 P.M. he made his official call on the British Commissioner at the Deputy Commissioner's bungalow. All the members of the British Commission were present, as well as Colonel Howlett, Commanding the Station, Major Munn, Commanding the Detachment, Royal Irish Fusiliers, Captain Fuller, Commanding the Mountain Battery, and Lieutenant Gould, the Station Staff Officer.

This ceremonial visit lasted nearly two hours, and was very tedious. On the following day General Liu, with a large retinue, visited the Fort and was shown over it by Colonel Howlett, and on the 10th the British Commissioner and the members of the Commission returned their call officially, and were received by a guard of honour of our own troops outside the compound, while inside from the gate to the steps, we walked through a double line of Chinese soldiers, who were armed with various patterns of rifles, Martinis, Colts, Sniders and Winchesters, as well as with *dahs*, and there were also displayed a good many standards. Here we remained for about an hour and a half being regaled with champagne, burgundy, etc., cakes, sweets, fruit and cigarettes, much in the same way as they were treated by us two days previously.

On neither of these visits was any business discussed, and it was not till the 13th December owing to the dilatory nature of the Chinese, that the first meeting to discuss preliminaries could be arranged.

Preliminary discussions with Chinese Commissioner.—This meeting took place at the Deputy Commissioner's house, and the discussion was long and troublesome, a hitch occurring almost immediately.

General Liu wished to take up a central position, with the main body of the Commission, and suggested Momein, from which parties could be sent north and south along the boundary, and to which all questions could be referred to the Commissioners by their subordinates. This after some discussion was abandoned, and it was agreed that the Commission should be divided into two parties, one working northwards from the Taping and the other southwards. It was also arranged after much talking that Mr. George, who knew the northern section well, should go there with Chen, while the

Commissioners themselves worked the southern section. As Captain Renny-Tailyour will have submitted his report on this section I shall practically say nothing more on the subject, beyond stating that we were in constant communication by helio and by telegraph through Bhamo with the Northern party, and all references were made by Messrs. George and Chen to Mr. Thirkell White and General Liu for decision, and in, I believe, every case matters were satisfactorily arranged.

The question of a starting point for the Southern party was then opened, and the British Commissioner, after previous discussion with myself and local officers suggested that we should go to a place called Lwe Leing, which is one of the points mentioned in Article 2 of the Agreement; and this place was pointed out to the Chinese Commissioner on our map and all the circumstances explained, namely, that there was a specially prepared road to this spot, and that from its position, it was a very suitable one to start from; there being no road along the southern bank of the Taping river, to get any other way to the point at which the boundary leaves the river and ascends to the Lwe Leing ridge would be very difficult, especially as there is neither bridge nor ferry between Myothit and near Momein, but they were very determined and for a long time insisted on going to Nampaung and commencing work from there on the grounds that this was the starting point of the Southern section.

It was then pointed out that the Northern party must go there and mark the junction of the Nampaung and the Taping, and that consequently it was unnecessary for the Southern party to do so also, that it was quite unnecessary for the Commission to go actually along the Taping river itself, the course of which in these parts cannot change, and that all we had to do was to find a suitable spot on the southern bank at which the boundary should *leave* the Taping, and to mark that as our starting point, and that the most convenient camp from which to do this would be at or near Lwe Leing.

The Chinese Commissioners then remarked that they had no such places as Lwe Leing or the Lwe Leing ridge mentioned in their documents, but that in place of Lwe Leing, was a name "Wălăn," which they said they believed was somewhere north of the Taping near Alaw Pum. Eventually, however, they agreed to go to Lwe Leing with us starting on the 15th, and the names of and distances to our intermediate camps were written out and given to them.

The question of the style of pillars to be erected along the boundary was also discussed at this and other meetings, the Chinese being anxious to erect *pukka* pillars at once. This would have caused much delay and was not necessary, and it was eventually agreed, that rough stone pillars should be built and a trench cut all round.

Subsequently they wrote to say that many other questions of procedure, etc., had to be settled and they begged that the start might be postponed till Friday, the 17th. The British Commissioner yielded in so far, that the start should be postponed till the 17th, and eventually we actually left Bhamo on the morning of the 18th. They were apparently much pleased at the respite, and I find in my notes that it was my impression that they had evidently now made up their minds to work smoothly after making the usual objections; this, however, was an entirely erroneous idea on my part. The whole Commission was photographed in a group on the morning of the 18th.

Survey work around Bhamo.—I have before mentioned that various parties were out clearing hill tops and flashing signals to Mr. Serrao. A station was selected on Alaw Pum by Ganu Mal and another on Naru Pum, which two hills had to be fixed by Mr. Serrao; a hill above the village of Kanlain, north of Bhamo, was also cleared for him by Mahmud Hussain; while another was cleared above Myothit for Captain Renny-Tailyour. Sheik Mahomed had been sent to Naru Pum with an escort, but did not clear it or apparently attempt to do so, and it was not until Friday, the 18th, that the hill was cleared and a signal was flashed to me at Bhamo by Ikbaluddin, whom I had sent there some days previously, in order that he might observe from it and thus avoid any further delay. Mr. Serrao subsequently reported to me that none of the surveyors showed him signals in a satisfactory way, and that his work was very much delayed in consequence, and he was given much extra trouble at, to us, a critical time. A fairly good base, however, was eventually secured.

While at Bhamo, the Executive Engineer was good enough to build for us a masonry bench-mark in a suitable spot, and this was subsequently connected by triangulation, and its position and height were determined by Mr. Serrao on his return journey.

The march to the frontier at Lwe Leing.—Our escort of 100 Military police had been previously sent on and were encamped at Momauk, 9½ miles from Bhamo, and at 1 P.M. on the 18th December the Chinese Commissioner and we ourselves left Bhamo under a salute; we went into camp and the Chinese who had no tents to speak of were given houses in the village of Momauk. This Camp was pitched in low ground, near the foot of the hills, and was damp and uncomfortable, however there was no choice. Next morning we left at 8 A.M. and marched up the hills to Lawtan camp, distance from Bhamo about 16¾ miles, the camping ground was very confined about ¾ mile short of the village of Lawtan, and about 3,300 feet above our last camp. The Chinese were again accommodated in the village and in grass and bamboo huts specially prepared for them.

On the 20th we reached Sin Lum, and halted the following day. This enabled me to get in my men from Naru Pum and to make a supplementary station on a hill not far from camp, from which, I took observations the same day.

On the 22nd we marched to Möng Loi, a very prettily situated village and camp in and above the paddy fields. On the 23rd we moved to Möngkha-Lwelong and camped on a knoll on the north side of the paddy fields, our escort being below us in the fields themselves, water being abundant in the stream immediately below us, namely, the Kulong-hka, the stream which in this neighbourhood had for some time been recognised as our administrative boundary. The Chinese were camped about ½ mile further back, as some huts had been prepared there for them.

Visit of the Möngwän Sawbwa.—In the afternoon General Liu, Peng (his assistant and adviser) and the young Möngwän Sawbwa paid a visit to the Commissioner and remained some time. The Sawbwa was introduced to us all round, he was in full Chinese official dress, and appeared very uneasy and nervous. Before leaving General Liu spoke to him very seriously, told him that we were his neighbours and that he was to cultivate friendly relations with us, he was to take note of each of us, in order that he might in future recognise and treat us with proper respect, he then re-introduced us individually andle ft. The Sawbwa was told at this interview how the boundary ran (in the agreement) and seemed much put out, but Liu made no suggestions. Next day, 24th, as we were now in new country we marched in more regular formation.

The march continued.—The few men of the Burma company of Sappers and Miners we had with us were usefully employed in improving some almost impassable places on the track. The top of the ridge is here of considerable width and densely wooded, and we marched down the wooded slope, past the village of We-ong to our camping ground at Lwe Leing. At Lwe Leing the Chinese and ourselves camped together, they being to the south of us and about 50 yards away.

Trip to the Lwe Leing ridge.—On the 25th, X'mas day, accompanied by a surveyor, Mr. Cholmeley (Deputy Commissioner, Bhamo), Lieut. Ffrench-Mullen and a small escort, I went up the hills to the north to try and reach the conical peak—on the Lwe Leing ridge, called Janmai Bum, which is a point on the boundary, the path took us through the villages of Manseng and Nong Chêng, at which latter place the people seemed either frightened or hostile. However, after a short time I managed to get a guide and soon they were re-assured and became quite friendly. After some delay here we started afresh, and reached a curious tract of country on the top of the range, consisting of a series of steep grassy knolls, separated by swampy hollows, the track winding about between the knolls. Finding it would be impossible to reach the point we were making for and have any time left for surveying, I decided to stop short on a commanding knoll, from which Lachman Jadu managed to do a lot of work, fixing all the Lwe Leing ridge to which rays had been drawn previously, besides other important points; as soon as this was completed, we retraced our steps reaching camp a little after dark. It was as well that I went out this X'mas day, and also that I decided to halt short of the hill and get as much work done as possible, as, though I had no thought at the time of its being our only chance of surveying this bit of country, it turned out we were destined never to be able to ascend the hills on this side again.

Reference to Governments.—On the 26th and 27th we had long conferences with the Chinese Commissioner. It was decided at the first of these conferences that we should leave standing camps, at Lwe Leing, and go with a small escort to the Taping to find a suitable starting point for the boundary, and that the survey of the country round was to be proceeded with. At the second conference it was arranged that to avoid delay, I should be allowed to go for a trip of 4 or 5 days into the hills to the north and north-east. At first General Liu requested that I should take an escort of 5 men only, but eventually agreed to my taking 15, the least number that it was in any way safe to have. My object was to survey all the ridge and the country between that and the Taping river.

Lwe Leing.—Enquiries on the spot from local head-men and others elicited the fact that the site of our camp was almost exactly that of the former village of Lwe Leing, which was situated on the banks of the Nam-pa-hka; that the little stream to the north-east of our camp used to be called the Lwe Leing hka, and flowed past the Sawbwa's house; that the spot on which our camp was pitched was still known to the Burmans as Kungon Taban and to the Kachins as Lwe Leing Taban, and that it was the spot at which, when following this route, the embassies from Burma to China were met by the Chinese authorities and where the escorts were changed, and that the meaning of the name is "the place where presents are given." Nothing more conclusive than that this was recognised as the boundary between the states under Burmese and Chinese rule could possibly be found, but as we were not searching for but merely demarcating a boundary, it was merely an interesting piece of information.

Our position at Lwe Leing and cause of withdrawal to (Möngkha) Lwe Long.—For the last few days Mr. Rae had been collecting information from friendly natives and by spies, and his enquiries showed that the Kachins of Hohsa-Lahsa-Möngmow and Möngwän were assembling to attack us or at any rate to oppose any attempt of ours to move forward from our camp. We were thus in a very unpleasant position, our camp was incapable of defence as it stood. It was difficult to get supplies and consequently when the General came over that evening, he was informed that it was thought best, as there was no wish to have any fighting over the matter and we did not wish to have trouble on the frontier, that we should all march to the Kulong-hka at Lwe Long the next day and there await the orders of Government. The Kulong-hka being the stream

which had been for some time past recognised as the boundary between the twos countries. To this General Liu readily agreed and it was eventually settled that we should march the next day and that he should follow the day after, as he wished not to move, till his reinforcements and the Möngna Sawbwa whom he had sent for had joined him. The fact of Liu sending for reinforcements shows that he expected trouble. Accordingly next day we returned to Lwe Long and were joined on the 31st by the Chinese, General Liu and Peng coming over at once to see the Commissioner.

General Liu's Birthday.—On 1st January General Liu, Peng and the Möng-na (Kan-gai) Sawbwa called on the Commissioner. They would do no business, but agreed to a conference on the morrow; this happened, however, to be General Liu's 59th birthday, and an unusually heavy breakfast so incapacitated him that it did not come off.

Lwe Long.—At Lwe Long where we had now settled ourselves, we were in heliographic communication with Bhamo, through two intermediate stations at Mongloi and Sinlum and here we remained until the Commission was broken up in April. Our only move being from the paddy fields which were getting rather insanitary to a spur above them, from which we had a very pretty view of the valley. The Chinese also moved their camp back about ¼ of a mile to a pretty wooded spur on the other side of the Kulong-hka.

I have previously mentioned that this stream, the Kulong-hka, had for some years been recognised as the boundary between the two countries and it seemed the most suitable place for a camp pending decisions on our disputes. The term applied to this boundary in Burma, was the "Provisional line" and up to it we had administered.

Chinese Search for Wālān.—For some time they were very busy in making enquiries regarding this imaginary place "Wālān," and they mentioned that they had located it several times, the *sites* varying considerably being always however west of our present camp and never north of the Kulong-hka. As however they had refused to sanction our surveying the country on their side, and we found that they were interfering with, giving orders to and misleading, our Kachins, the Commisioner very properly informed Liu that while he would give them every opportunity of making enquiries, provided they gave him warning and were accompanied by some of our people as escort, he would on no account allow any Chinese Officials or armed parties to cross the "provisional" frontier unattended. This was a most necessary and important action and was thoroughly understood by the Chinese.

Our visit to Matin and the Sawbwa's evidence.—On the 3rd January the Commissioner rode over to Matin, Mr. Rae, Captain Norie and I accompanied him. The Matin Sawbwa, who is one of the most influential chiefs in the neighbourhood, is blind, but pleasant old man, very superior to the mass of the "*duwas*," he seemed very pleased to see us, and we had an hour's talk with him. He volunteered that there was no such place as "Wālān" which showed that the Chinese had been there making enquiries; he also told us that the "Tai-pi-kwan" one of the "gates" given back to China by the "Convention" was in the neighbourhood of Pakwān, and this I subsequently verified as on the 20th when I was at Kadaw Kongra, I went to see it at Mungdung village. Also that he knew Lwe Leing and the streams around and that the Lwe Leing and Kangma streams were practically identical; that the stream formed by the combined Pautai Nampa and Kangma hkas was called alternatively the "Lwe Leing" or "Namwa" hka, a further confirmation of our previous information, and this was satisfactory as previous to our visit to that spot, no Europeans or surveyors had visited Lwe Leing at any rate since the annexation of Upper Burma, and its position was merely inserted on the survey of India maps from native information.

Mr. White proposes commencing work on Shweli section.—Immediately on our return we received a call from the Chinese Commissioner, and during the visit Mr. Thirkell White endeavoured to persuade General Liu that the whole party should proceed to Namhkam and commence work on the Shweli section.

This they would not agree to, going over all the old ground about Wālān and the "Taping nor" and insisting that the junction of the Nampaung and the Taping was the place we should go to.

Further attempts to commence work.—During the next few days further attempts were made to get the Chinese to start work on one section or the other, but with no results.

Survey work (Shweli Valley).—Meanwhile I had been employing Lachman Jadu in surveying all the country on our side of the Kulong-hka, while I and Ikbaluddin were working out computations, and on the 11th all the work in the neighbourhood having been finished, I arranged with the Chinese that Lachman Jadu should go to Namhkam with a Chinese Officer and survey all the country adjacent to the Shweli river on both sides, in order that there should be nothing to delay us, when we commenced work on that section; he left on the 13th and completed the work told off to him, as far as he was enabled to do, and returned to camp *viâ* Bhamo on February 18th. He reported that he practically received no assistance from the Chinese official, who was sent to accompany him—beyond being supplied daily with a guide—and that he was not allowed to survey freely on the Chinese side of the river, consequently he had no more than what was undisputed British territory on his plan.

Further discussions with the Chinese.—So things dragged on until the 25th when the Chinese came over and said that that they had received orders to go by the

reply to our "reference," which reply was that if it was found that we could not arrange matters on this section, we should leave it and proceed to work on the Shweli section. Next day Liu informed Mr. White that he had telegraphed for permission to commence on the Shweli section.

Kan-gai and Möngwān Sawbwas begin to be actively hostile.—All this delay, which was unavoidable, however, encouraged the local Sawbwas to show more or less open hostility to us, and early in February the Kan-gai Sawbwa, one of the most powerful, took upon himself to assert rights over the territory immediately north and east of the Kulong-hka, he refused to allow the Kachins on our side of the stream to cultivate land on the far side, as they had been in the habit of doing, and proceeded during the course of the next few weeks to erect stockades all along the line. The first that came to our notice was one on the road from our camp to Lwe Leing, and this was garrisoned by some Chinese Shan Levies and Kachins. Liu said that this was erected to protect his (Liu's) convoys of provisions, etc.; and for no other purpose, but when others came under our notice, this excuse was of no avail. The village of Khukha only a few hundred yards from our camp was stockaded and the trees round it cut down; and a big stockade was erected with much display of bunting at Yinfan. In fact on our front and right flank no less than 20 stockades were built; they were placed as follows:—

2 at Hpa-lum.
2 „ Khukha.
1 on road to Lwe Leing.
1 at Yinfan.
1 „ Lakhum.
1 „ Krinmudan.
1 near Kam-gau.
2 „ Kan-hsa.
3 „ junction of the Taping and the Kulong-hka, and
3 „ Lwe Leing.

None of these were probably at all formidable, but to force a way past them would mean the loss of some lives at any rate, and showed the spirit of the Sawbwas, and can only be regarded as an act of hostility. General Liu was remonstrated with, but said that it was only within the rights of Chiefs and villagers to take any means they pleased to protect their villages; and as they were outside our provisional line though all of them inside the "Agreement" line, pending some proper decision on the points referred to the Government at Pekin or the despatch of reinforcements to us, it was unwise to insist on their being dismantled. It was later admitted by the son of the Kan-gai Sawbwa and the Regent of Möngwān that the stockades were erected to bar our advance. They were warned that any encroachment into territory administered by us at any time would be severely dealt with, and notwithstanding this they later proceeded to erect stockades at Sadôn and other places on our side of the Mantein hka, and these, though adjoining Möngwān, were partly garrisoned by Kan-gai's troops, who actually left the Chinese camp in full view of us, with many standards and marched across the hills.

Langtry carries and destroys the stockade at Sadôn Sengmye, etc.—The Government of Burma had however been informed and retribution was speedily to follow, for a detachment of Military Police under Lieutenant Langtry, with Mr. Hertz as Civil Officer, was despatched from Bhamo and on arrival found them occupied, and were fired on. The police charged and carried the stockades, Lieutenant Langtry and two or three sepoys being wounded. The Chinese fled, leaving 7 dead, 25 prisoners and 9 standards in the hands of our men. In this action, the first in which the sepoys of the newly raised Kachin Company of the Bhamo battalion were engaged, they behaved splendidly, hacking down under fire the stockade with their *dâhs*, and one of them was severely wounded in a hand to hand encounter with several Chinese, during the pursuit. This and the other stockades in that neighbourhood which were found to have been evacuated were levelled by Lieutenant Langtry's party.

The Commission breaks up.—We parted quite friendly as in fact we had always remained, notwithstanding the official troubles and disputes, and on the 2nd April the British portion of the Commission, having established a post of 200 Military police, who had been sent up from Bhamo as reinforcements early in March, on a hill commanding the whole of the paddy fields of Lwe Long, within rifle range of the village of Khukha and commanding the trade route between Bhamo and Möngwān.

Some little time before we left, the regent of Möngwān, a fine determined-looking woman, step-mother of the Sawbwas, came in to see the Commissioner and plead his (Möngwān's) cause. She remained some time in a camp adjoining the Chinese and Môngna's (Kan-gai's).

I had met her before in Namhkam in 1894, at about which time I had made the acquaintance of Kan-gai, who then appeared very friendly, and who supplied me with some special cigars of his, which, he said, were unusually good.

General Liu found it inconvenient to leave Lwe Long quite so soon as we did. We reached Bhamo on the 5th April and I remained there, completing as far as possible my maps and settling matters for the northern party, till the 10th, when I left for Mandalay, where I stored the camp equipment and instruments, and on the 14th I rejoined the Commissioner at Maymyo, reporting my arrival to the Lieutenant-Governor, who was there at

the time, and I stayed there mapping and writing a report, which the Commissioner required of me, till the 20th, when I left with the late General Woodthorpe for Mandalay and India.

General deductions.—Thus it will be seen that we were no nearer any settlement of our disputes, at the end of the four months the Commissions were together, than we were the day we first met.

There is no doubt that the frontier Sawbwas had not been advised of the fact that the Commission was to start work, nor were the terms of the agreement imparted to them and our arrival to carry out the work came unexpectedly and as a disagreeable surprise to them.

The time, however, was not all thrown away; I was enabled to get done a considerable amount of survey work with my surveyors, and a good deal of triangulation was carried out and computed, so that there are ample points fixed for work next season, and the country is known.

Behaviour of escorts, etc.—The behaviour of both escorts throughout the season was excellent, and, except on one occasion, there was nothing but the utmost cordiality between both camps, and this was on the occasion of the flogging of some muleteers for theft, bludgeons and arms were seized by an excited crowd of men, and there was a great deal of noise, however no blow was struck, and after some trouble the camp was cleared and quiet was restored. Next day, under a strong guard, the men were properly flogged, as well as one of the ringleaders of the riot, and from that day there was no trouble whatever. Though General Liu had a flogging parade some time later, owing to his finding that his men spent a good deal too much time in gambling, and with money probably stolen from himself and other Chinese officers, as they had several thefts in their camp.

Chinese copy our customs.—None of the Chinese had any knowledge of surveying or of the use of surveying instruments, so those supplied to them on payment from Calcutta at their request, were never brought into use.

It was amusing to note the way they copied us in everything. At first they did not fly a flag, but seeing we always did a very enormous one with Liu's name on it was soon to be seen floating over the entrance to his tent. If we went out for a ride, some of them would start for one on their side of the stream.

We used to send our ponies for exercise on a track made for tent-pegging in the paddy fields, they almost immediately commenced doing likewise. If we had a little revolver practice, within a few minutes you heard shots in their camp. The Chinese soldiers began to salute, as in English fashion, and stand to attention, at times when we passed. And they took the keenest interest in our parades and drills crowding round to see exactly what was done.

When in Bhamo, they of course heard the morning and evening guns fired by the Mountain Battery there. Consequently, we were destined, while in camp, to have an explosion of powder, every morning at about sun rise and at sun set, as soon as the last note of their horns was blown, they sunk some powder in a tube into the ground as they had no gun and fired this by means of a train of gunpowder. They took down their flag with ours at sunset.

On the 22nd January I returned from Kadaw Kongra just in time to reach the Head-Quarter Camp in time to see the eclipse of the sun. There was great excitement in the Chinese camp. They were all on the alert, firing guns, blowing horns and beating drums. This noise and excitement were kept up until the sun was once more free. They explained that they did it to frighten away the dog, which was attacking the sun.

Kachins on our side of the border.—Throughout the season I was much struck wherever I went by the great cordiality and friendliness of the Kachins in our territory, who seemed as happy and contented as men could be. It was rather a surprise to me, as my experiences on the other side of Namhkam, 4 years before, were not by any means the same, and the fact reflects great credit on Mr. Rae, the Civil Officer, and other officers of the Bhamo district. The Kachin sepoys also, many of whom come from these parts, were most happy, cheerful little chaps, and we had some most useful men in the Kachin dooly bearers, who kept us supplied with firewood, carried our *dâk* and made themselves generally useful. They had, however, a sincere friend in their commanding officer Lieutenant Ffrench-Mullen, and they thoroughly appreciated and reciprocated his feelings.

Behaviour of Survey detachment.—As regards the Survey party, I can give nothing but praise on the subject of their behaviour. They gave no trouble to any one and the *khalâsis* were always ready to do anything. Ikbaluddin and Lachman Jadu did all that was possible in the way of surveying, and it was due to the fact that our movements were so restricted that we did not secure a large outturn.

Health.—The health of the whole party was, throughout the year, wonderfully good and the men were well looked after by a very intelligent hardworking hospital assistant attached to the military police.

Note on the topography, etc., of the country traversed by the Southern Section of the Burma-China Boundary Commission, Season 1897-98.

1. *General description.*—The country to which the operations of the Southern Section of the Boundary Commission during 1897-98 was confined lies between the river

Taping on the north and the Namwan on the south. These streams in the area under review flow parallel to one another in a south-westerly direction, and at an average distance apart of about 30 miles as the crow flies, approaching nearest to each other at a boundary line between the two countries (Burma and China) where the distance apart is only 24 miles, the boundary itself as laid down in the Agreement following almost exactly the shortest line.

The streams are by no means identical in character. The Taping, which is by far the biggest, rising in far distant hills, is a deep, rapid stream flowing between steep, forest-clad hills, is a serious obstacle, and cannot be crossed between Manwaing and Myothit, at both of which places there are ferries, except in one or two places by foot passengers over bamboo suspension bridges; while the Namwan, rising in the more immediate neighbourhood, flows gently for some considerable distance through the fertile valley of Möngwān, and is crossed by several bridges, eventually passing into the hills at the south-west end of the plain, where it is joined from the north by the Mantein *hka*, our present provisional boundary in that region, and continuing to flow south-east for some 30 miles as far as Namkhai, at which point it turns abruptly to the south-east, and eventually discharges itself near Namhkam into the Shweli.

This latter river has also a south-westerly course, and from its junction with the Namwan forms the boundary to the north-east for a distance of some 25 miles till joined by the Namyang, a small affluent from the east.

2. These three rivers are separated from one another by two high ranges of hills, that between the Taping and Namwan being by far the grandest, the highest and most broken, more wooded and offering extensive and magnificent views. The hills gradually diminish in height from the highest, Namkhai Pum (8,687 feet), immediately over the Taping on the north-east, to the peaks on the spurs overlooking the Irrawaddy valley, which run to about 4,000 feet; but almost in the middle of the area, and slightly detached from the main range, rises the fine peak Naru Pum (7,867 feet) above the sea, visible from Bhamo, from near Namhkam and other important places, and from which a most extensive view is obtained in all directions.

The principal peaks on the range starting from the north are Namkhai Pum (8,687 feet), Khokhai Pum (7,720 feet), Janmai Bum (6,835 feet) (the boundary peak above Lwe Leing), Inrakawng (6,384 feet), and close to it Lwelong or Pantein Shan (6,290 feet), on which is the grave of a former Kachin *duwas* (Chief) of Lwelong, and over which the trade route between Bhamo and Möngwān passes, the hill above Krinmudan village (7,350 feet) and Naru Pum already mentioned. Near Janmai Bum the range is joined by another, of which Loi Pangkham (6,864 feet) was the highest peak seen. This range forms the southern and eastern boundaries of Hosa and Lasa, and in reality is the main range, that previously mentioned being cut through between Khokhai and Janmai Bums by the Namsa, which, draining the Hosa-Lasa basin, forces its way through the hills to the Taping.

The hills are very steep and rugged, the valleys deep, and, except in the case of the Kulong *hka*, little cultivated. Having from time immemorial been subjected to the devastating system of *taungya* cultivation, the hills are much more bare of real forest than one would expect or even judge them to be when looking at them from a distance.

The clearing is absolute, not a tree being left where cultivation is intended, and an enormous area is consequently denuded and covered with dense impenetrable *kaing* grass and small jungle. This grass, from even a short distance, gives the impression that the hill is bare, but growing to a height of 10 or 12 feet it is most difficult to contend with until the jungle fires, which occur from April until the rains have swept it away, when no doubt the hills become practicable, though till then one cannot leave the beaten track.

Water is abundant, though not in large quantities in any particular spot, except, of course, the main water-courses, and in many places there is a considerable amount of terraced rice cultivation, notably about north Hoton, Matin, etc.

3. *Streams, etc.*—The main streams in this tract, starting from the north-east, are—

(*a*) The Namsa, which drains Hosa and Lasa and falls into the Taping. (The actual course of this stream has not been surveyed, but is approximately known).

(*b*) The Kulong *hka*, of which the whole course has been surveyed this year on the scale 1 inch = 1 mile; and

(*c*) The Nantabet *chaung*, both flowing into the Taping.

(*d*) The Namsiri, which, with the Nantabet, rises in Naru Pum and which flows into the Irrawaddy south of Bhamo.

(*e*) The Nammapwe *chaung* with a fairly large catchment area, rising at Pumsen Pum, draining the country between that hill and Karwan, and eventually flowing into the Irrawaddy, four miles south of Bhamo; and

(*f*) The Nammu, which flows into the Sinkan *chaung* and thence to the Irrawaddy.

While flowing into the Namwan and Shweli are the Namwa or Lweleing stream, the Mantein *hka* and the Nammak. There is nothing remarkable about any of these streams except, perhaps, the Kulong *hka*, the bed of which is very level for some miles at an altitude of about 4,400 feet, admitting of rice cultivation on either bank, when it suddenly assumes its proper rôle of a mountain stream and falls rapidly and in torrents to the Taping. There are some fairly big falls in several streams, the beds of which are all

picturesque, one below Sinlum being several hundred feet in height by report, though not one clear fall.

One curious feature about several of these streams was observed, namely, that though there was abundance of water and many fine pools, not a fish of greater length than, say, 1 inch appeared to exist.

4. *Villages.*—The principal villages met with are *Matin* (Chinese Matang), on the southern slopes of the Taping, with its blind but very intelligent Chief, who was visited by the Commissioner and myself in January, and who owns the most imposing house in these hills, it being surrounded by a mud and brick or stone wall and approached by a flight of stone steps leading through a Chinese style of gateway into the outer courtyard, which in this case surrounds an ordinary Kachin house, though one of much better construction than is usually the case.

Hoton.—A large village near Matin and situated on the ridge forming the north-eastern edge of curious depression in the hills overlooking the Taping and south of the Kulong *hka*.

Chikai.—Another large village close by, with considerable rice-lands.

Möngloi.—On the trade routes between Bhamo and Möngwān, a very prettily placed village with fine trees and much cultivation.

Hpalum.—North of the Kulong *hka.*

Pomshi.—On the slopes of the Taping between the Mankong and Kuli *hkas.*

Lakhum.—A large village or cluster of villages on the spur south of the upper waters of the Namwa and near Lweleing and Ngaseing in the Möngwān valley.

5. *People of note.*—The Matin and Hoton *Duwas* appear to be the most influential of our Kachins in this neighbourhood, while a most useful guide is to be found in the *Pawmaing* of Möngloi, an old but energetic man, with great knowledge of the country.

6. *Roads.*—The country is traversed by many paths following generally the watersheds, after the usual Kachin fashion, but these, owing to the exertions and influence of Mr. Rae, the Political Officer, have of late been much improved and some very creditable traces have been worked, as between Lwelôn and Chikai, Möngloi and Kadaw Kongra, and Möngloi and Matin, but much remains to be done, and the trials of the transport between Sinlum (up to which place a well-laid-out path has been made from the foot of the hills on the Bhamo side by Mr. Cholmeley, Deputy Commissioner, Bhamo, and which may stand the rains) and Lwelôn post during the rains are appalling to contemplate, the line selected by the Kachins between these places apparently following the steepest instead of the easiest gradients.

7. *Tai-pi-kwan.*—One curious discovery was made during this season, and that was the finding of the Tai-pi-kwan in a most unexpected place in Mundung village near Pakwan. I supplied Mr. Warry with a drawing of this stone, which was unearthed by some Chinese explorers. It was in two pieces and half-buried, having been treated with some want of consideration by the Kachins, who had periodically thrown it down the *khud.* The Hoton *Duwas* suggested that the proper place for it was the bottom of the Taping river.

8. Game was not abundant, but by dint of great perseverance Mr. Warry secured a few silver-pheasants, bamboo-partridges and francolin, a woodcock, snipe, and a few quail. Sambhur and barking deer as well as *serao* are to be had, but are rare, and one hare is known to exist. A fine bear was killed close to camp at Lwelôn after an exciting fight and vast expenditure of ammunition by the Kachin sepoys, assisted by some Dogras, an orderly with a fixed bayonet, and a large audience of officers, Kachins, sepoys, followers and Chinamen. It was an exciting time, but no one was shot. The doctor was in attendance with a case of surgical implements and a dresser.

Some rare and one or two new butterflies were secured.

Lweleing.—Lweleing camp, at which place in former days the Burmese escort with tribute to China was usually exchanged for one of Chinese soldiers, is situated in a hollow, at an elevation above the sea of about 3,600 feet, and is almost entirely surrounded by hills, which are highest on the north and west, and the direct road to it from Bhamo, which passes over Pantein Shan, is steep and difficult. The hills round are densely wooded and rather thickly populated, though there is little cultivation about. There are four streams meeting practically at this spot, namely, the Namwa, the Pautai *hka,* the Nampa *hka,* and the Kangma *hka,* and the combined stream under the name Namwa flows at a distance of a mile to 1½ miles through a narrow pass into the low undulating country bordering the Möngwān paddy plain. Close to Lweleing camp we found, what appeared to be the remains of an old fort or gate still visible, a stone causeway separating two swamps, being in a fair state of preservation.

Narrative report by CAPTAIN T. F. B. RENNY-TAILYOUR, R.E., *Officiating Superintendent, 2nd grade, on the Survey Operations with the Burma-China Boundary Commission, Northern Section, season 1897-98.*

The survey detachment detailed to accompany the northern party is given in the margin. Mr. E. C. S. George, C.I.E., I.C.S., was the Sub-Commissioner with the northern party, Mr. Hausser, of the China Consular Service, was the Chinese adviser, and Lieutenant W. R. Scharlieb, I.S.C., was in command of the escort consisting of 100 Military Police from the Bhamo Battalion; there were also 10 men of the Burma Sappers and Miners to erect the cairns. The transport consisted of Chinese mules.

Captain T. F. B. Renny-Tailyour, R.E., Officiating Superintendent, 2nd grade.
Surveyor Mahmud Husain.
Sub-Surveyor Abdul Rahim.
33 *Khalásis*.
3 Interpreters.

Our programme was to demarcate the boundary from where the Nampaung river joined the Taping river northward to a high peak the approximate position of which was supposed to be latitude 25° 35′ and longitude 98° 14′. The country through which the boundary passed was not well known and the existing maps turned out very unreliable.

I arranged to do the triangulation myself, Mahmud Husain was to survey as much as possible on the ¼-inch scale assisting with the 1-inch when required, and Abdul Rahim was to survey along the boundary on the 1-inch scale, also surveying on the ¼-inch when possible.

The Chinese had very little idea of the country where we were going to, and Mr. Chen, the Sub-Commissioner, said it was impossible for him to go the whole way as he could ride "no better than a turtle." It was eventually decided that he should go as far as Warawng Pum hill, and that another Sub-Commissioner should meet us there.

It was arranged that we should meet and discuss details with Mr. Chen at Nampaung, a small Military Police post about 30 miles from Bhamo on the main road to Momien, and within a mile of where we commenced demarcating the boundary.

I left Bhamo on the 17th December, a day before Mr. George, as I wished to visit and observe from a hill near Myothit. Mr. George with the main party caught me up at Myothit and we arrived together at Nampaung on the 20th, Mr. Chen arriving the next day.

At the first interview with the Chinese we got a very fair idea of the difficulties we would have in working with them. It was, however, decided at a subsequent interview that Abdul Rahim and the Chinese surveyor should proceed along the boundary and choose the site for the cairns, but in the event of their being unable to agree the matter was to be referred to the Sub-Commissioners.

While at Nampaung I made a station on a hill to the west and connected up with the station near Myothit; owing, however, to the confined nature of the country, these stations were useless for my main extension.

We left Nampaung on the 28th and arrived at a camp near Alaw Pum hill on the 29th December. The highest part of this hill had been cleared and observed to by Mr. Serrao who was extending from the G. T. series. I observed to Mr. Serrao's stations from Alaw Pum and the connection gave very good results on which to base my main triangulation.

The Chinese objected to the boundary line near Alaw Pum and after several interviews the matter was referred to the Commissioners. In the meantime I formed a second station near Alaw Pum and another near Nawku about four miles further on, to which village we moved camp on the 8th January.

None of the country we were going through had been triangulated before and I was very anxious to get as much work as possible done before the haze set in, and, if possible, to keep the plane-tablers always supplied with points; consequently, as it was uncertain when the disputed questions would be settled, I arranged with Mr. George to go on ahead with Mahmud Husain and an escort of 25 men.

I was delayed a few days waiting for rations and did not leave Nawku until the 14th January. During the time I was separated from the main party I observed from five stations, and the weather being good, I managed to fix a large number of points, some of them well in advance of the work; Mahmud Husain was also enabled to do a considerable amount of plane-tabling on the ¼-inch scale.

The difficulties with the Chinese near Alaw Pum were settled towards the end of January and the main party moved on slowly. I joined them on the 8th February at Pajau, a large Yawyin village about 13 miles from Să-ma and on the main road between Să-ma and Si-ma-pa.

At Pajau we again came to a standstill with the Chinese and were delayed there as well as at Paknoi Prang, to which place the main party moved on the 25th February. During the delay I went for a small tour by myself and formed some new stations. We found it very cold at Pajau and Paknoi Prang which were both at an elevation of nearly 7,000 feet, and frequently there was thick ice in the mornings on the basins inside our tents.

We left Paknoi Prang on the 4th March and moved on slowly so as to give time for the 1-inch survey and for the cairns to be erected. In order to expedite the work Mahmud Husain was here told off to survey a portion of the boundary.

We were delayed again at Lung-pien village owing to Mr. Chen refusing to allow us to march through China, but as the road on our side of the boundary was a very long way round we insisted and eventually gained our point.

On the 7th April we arrived at Sansi gorge, a very cold and windy camp, over 9,000 feet elevation and close to where the boundary crosses the main road from Myitkyina to Momien. A few miles beyond Sansi gorge there is a high peak called Tābu Pum about 11,200 feet elevation. I was most anxious to visit and observe from this hill, and moved on to a camp near it. Luckily we had heavy rain about this time which cleared away a good deal of the haze, but owing to clouds I had to spend three days on the hill before I got satisfactory observations.

From the camp near Tābu Pum we marched by a very rough road to Waw-hkyun (a temporary Military Police post), and here I made a station. We then moved on to Kambaiti camp which is at an elevation of nearly 7,000 feet. This camp lies to the south of Warawng Pum hill previously mentioned, and is on one of the trade routes into China. From Waw-hkyun I had sent Mahmud Husain with Mr. Duff, the local Civil Officer, to survey on our side of the boundary up to the position of the high peak where we were to finish work, nothing being known of that part of the country.

As the Chinese Sub-Commissioners changed at Kambaiti, a map in duplicate of the boundary on the 1-inch scale up to this point had to be prepared, these were both signed and sealed by Messrs. George and Chen, and one kept by each.

After the final interview with Mr. Chen we had a meeting with Colonel Yang, the new Sub-Commissioner, and at once found that the change would cause us considerable delay. Colonel Yang refused to allow us to go through China, among other reasons stating that there was a rising on his side. From Kambaiti to the end of our work was only 3 marches through China, but on our side it was 5 or 6 marches round, so naturally we insisted on the former road. The matter was referred to the Commissioners and General Liu, the Chinese Commissioner, twice telegraphed to Colonel Yang from Momien to allow us to proceed. These telegrams came in English and were translated by Mr. Hausser to Colonel Yang, who evidently did not consider them genuine and must have written to this effect to General Liu, for a few days later, we were much amused by another telegram arriving from General Liu. The next day he withdrew his objections to our going on through China.

Since the 26th April it had been raining more or less continously, and the streams being in flood it was considered impossible to send on more than a small party, consequently Abdul Rahim and the new Chinese surveyor started off on the 6th May leaving the main party at Kambaiti. The surveyors reached a high hill near the position given as the high peak in the convention, put up cairns there and returned to Kambaiti on the 13th May, after an extremely wet and difficult journey. Mahmud Husain returned with Abdul Rahim.

Another map in duplicate was drawn and the final interview was held on the 14th May.

While at Kambaiti the weather was most unsuited for surveying and we were seldom without heavy clouds or mist. I made two stations, one of them on Warawng Pum (which was at an elevation of over 11,000 feet). I visited them on the three finest days we had, but even then experienced great difficulty in getting the observations I required.

In this part of the country the regular rains had evidently set in, and as we were anxious to get away before the roads became impassable we left Kambaiti on the 15th and marching hard reached Myitkyina on the 19th May. On the march down I observed again at Waw-hkyun and formed stations at Sadôn and at Warraw Pum, a hill between Waw-hkyun and Sadôn which had been cleared in advance.

The defile on the Irrawaddy river above Bhamo had been closed for steamers at the beginning of May, but was luckily now open enabling us to get down to Bhamo by river instead of having to go round by Mogaung and Katha. Four small steamers were put at the disposal of our party, and leaving Myitkyina at about 4 A.M. on the 20th, we arrived at Bhamo in the evening of the same day.

I got the survey party on to a Government steamer from Bhamo to Mandalay and catching the next Madras steamer from Rangoon, reached Bangalore on the 2nd June.

Owing to the ways of the Chinese and the inaccuracy of the existing maps it was generally necessary to have the country near the boundary surveyed on the ½-inch scale in advance, and on several occasions I could have employed a third surveyor with advantage. The Chinese hampered us a good deal, and our escort was also hardly large enough to supply separate detachments for myself and the two surveyors, let alone the question of keeping them supplied with rations. Taking, however, everything into consideration I think the outturn of survey work was very satisfactory: 4,750 square miles were triangulated, 690 square miles were surveyed on the 1-inch scale along the boundary as well as 1,960 square miles on the ½-inch scale. I was able to carry on the triangulation throughout and observed from 20 stations and fixed 132 intersected points; by working out the triangulation roughly in the field, I was almost always enabled to keep the surveyors supplied with fixed points. Among the intersected points I fixed as many distant hills in China as possible.

In recess my triangulation has been carefully computed and has worked out well. The 1-inch work has been fair mapped in 6 sheets, and the ½-inch work has been drawn out in a special map, all for reproduction in two colours.

The general health of the survey detachment was very good in spite of a good deal of wet and cold weather; the *khalásis* were all given rations, and consequently fed a good deal better than usual.

I am very much indebted to Mr. George for all the help I received from him; from start to finish he did everything he possibly could to assist our work.

Surveyor Mahmud Husain is very energetic and hard working and surveyed most of the ¼-inch work. At one part of the season he had a bad foot, and I had to send him for a short time to the hospital at Să-ma until it was healed but he himself was most unwilling to stop work.

Sub-Surveyor Abdul Rahim showed much zeal and energy and worked very well. He was principally employed on the 1-inch work along the boundary, and by his tact and the friendly terms on which he kept with the Chinese considerably facilitated the work of the Commission.

Extract from the Narrative Report by MR. J. BOND, *Extra Assistant Superintendent, 3rd grade, on the Assam Revisionary Triangulation, Season 1897-98.*

The triangulation was carried out with one of the modern 8-inch micrometer theodolites, the vertical and horizontal limbs being graduated to 10 minutes, and the micrometer heads of the microscopes to 10 seconds, and by estimation, reading to single seconds. The work was executed after the method of the best class of topographical triangulation, but a greater number of zeros were used, namely, L. 0°, R. 180°, L. 45°, R. 225°, L. 90°, R. 270°, L. 135°, and R. 315°. All the observations were taken to heliotropes except in the cases of two intersected points. It was also intended to use lamps for night work, but they were not ready when the party took the field, and they would have been of little use during the cold weather, owing to clouds settling on the hills at night.

I proceeded by rail from Poona on the 12th November 1897, and arrived at Allahabad the following day, where I was joined by the members of the party who were on recess leave and by Surveyor Syed Zille Hasnain, transferred from No. 14 Party, who brought with him from Katni the camp kit of the party which had been stored there at the close of the previous season's levelling operations.

On the completion of arrangements for the field at Allahabad, I despatched the establishment, as under, to Gauhàti on the 20th November: Surveyor Syed Zille Hasnain, Sub-Surveyor Balwant Atmaram, 30 *khalásis* and 1 *peon*.

The camp kit was forwarded by goods train and the men had to see it safely transhipped at each junction station and ferry between Allahabad and Gauháti, which caused a delay of three days before reaching Jatrápur railway terminus, where a further delay of two days occurred for want of room in the steamers: thus the men and kit did not reach Gauháti until the 29th November.

I myself went to Calcutta to collect the instruments, maps, etc., required for the triangulation, and after receiving instructions from Major Burrard in the use of the micrometer theodolite, not having had the opportunity of using one before, I proceeded to Gauháti, arriving there on the 1st December, a couple of days after my detachment.

It was considered advisable to proceed to Shillong in order to obtain information and assistance from the civil authorities before beginning the observations along the Eastern Frontier Series. The whole party accordingly marched to Shillong, where it arrived on the 8th December, and after unpacking and adjusting the instruments and training the signallers, the several squads were sent to their respective stations, while I went with the main or observing camp to Rangsanobo H. S. near Cherra Poonjee, and commenced observations on the 21st December.

The stations visited are shown in the accompanying chart; the dates of closing observations are as follows:—

Rangsanobo H. S.	24th December.
Mopen H. S.	6th January.
Mosingi H. S.	13th „
Laidera H. S.	28th „
Mautherichan H. S.	9th February.
Maonai H. S.	16th „
Maophanu H. S.	25th „

No approximate work had been done beyond the new station of Maophanu H.S., which had to be introduced on account of Maopáni H. S. of the old work having been so completely destroyed, that it was found impracticable to rebuild it without great loss of time and very heavy expenditure.

It was now rather late in the season and the atmosphere had become so hazy that neither the signals nor hills were visible. As the observations already taken had supplied sufficient data to show that the stations of the Eastern Frontier Series had been affected by the earthquake, it was deemed expedient to suspend further observations along it, and to try what could be done on the Brahmaputra series, as it would be interesting to know if the stations in the Gáro hills had also been affected. I accordingly closed my observations at Maophanu H. S., and was obliged to send messengers to recall the signalling squads; this necessitated great delay, and the signallers did not join me at Shillong until the 8th March.

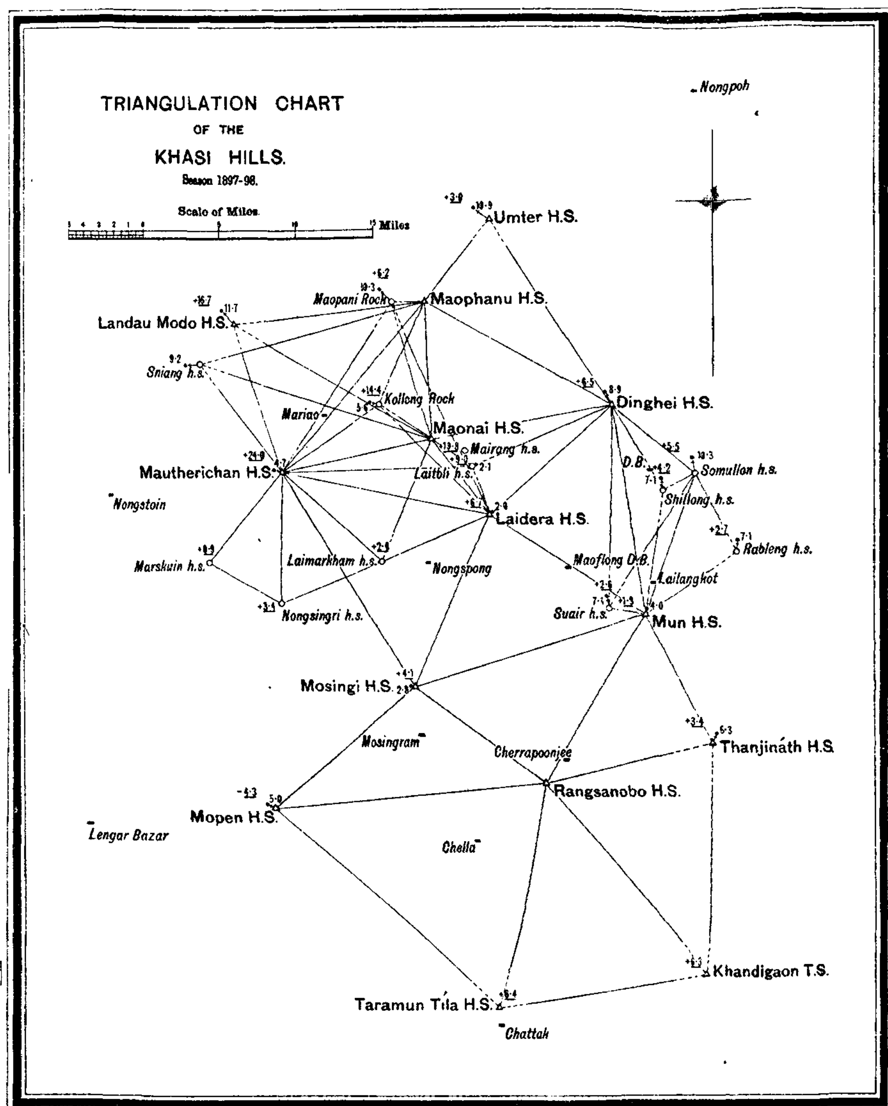


Photo. S. I. O., Calcutta.

REFERENCES.

Figures underlined are the alterations in height in feet, + denoting an upheaval and — a subsidence, on the assumption that the height of Rangsanobo H. S. remained unaltered. Other figures denote the lateral displacements in feet, and the dots show the relative displacements exaggerated, and the arrows their directions.

NOTE.—The triangulation emanates from the side Taramun Tila H. S. — Rangsanobo H. S. assumed to be unchanged.

Reg. No. 595. S. I. D.—Jan. 99—503.

The party left Shillong on the 11th March, arrived at Gauhâti on the 13th, and thence took steamer, reaching Dhubri on the 15th. The signalling squads were at once despatched to the surrounding stations of the Dhubri polygon. I prepared for observations by having the Dhubri station platform rebuilt, as it had been destroyed by the earthquake. To my great disappointment, the atmosphere was so thick with clouds of dust and sand from the Brahmaputra, that the opposite bank of the river was not visible and no observations could possibly be obtained on this series. Messengers were sent out on the 24th March to recall the signalling squads, and the detachment once more assembled at Shillong to connect the trigonometrical points in its vicinity.

Observations were completed as follows:—

Mun H. S.	15th April.
Dinghei H. S.	22nd „
Somullon H. S.	29th „

The party returned to Shillong on the 30th April, and proceeded on the 4th May, *viâ* Gauhâti to Dhubri, to pick up the sick members of the party and the spare kit that had been left behind on the return of the party to Shillong.

I sent the *khalásis* away to their homes on the 10th May and proceeded, in accordance with instructions, to Calcutta with the instruments and camp equipment. The instruments were made over to the Mathematical Instrument Office for deposit, and the camp equipment was stored in the Surveyor General's Office, after which I left Calcutta on the 14th and arrived at Poona on the 16th May.

The health of the party was good until about the end of the season, when, in the attempt to start the observations on the Brahmaputra Series in the middle of March, influenza and malarial fever began to attack the establishment. When we were leaving Dhubri to return to Shillong to strengthen the triangulation by observing at Mun H.S., I was obliged to leave the surveyor and 4 men behind for medical treatment; subsequently 5 others fell ill, and I was thus deprived of the services of a large percentage of my small party.

There was one death during the season, that of a signaller who succumbed after two days' acute illness brought on from the excessive cold and bad weather experienced on the highest of the hill stations.

The season's outturn is as follows:—

Horizontal and vertical angles were taken at 13 stations, of which 2 were newly selected ones, fixing the positions of 22 and the heights of 25 stations.

The following table shows the outturn of work:—

Assam Revisionary Triangulation Season, 1897-98.

Description of Work.	Number or Amount.
Principal stations observed at	7
Auxiliary principal stations selected and observed at	2
Principal stations connected but not observed at	4
Secondary stations observed at	4
Secondary stations and intersected points connected but not observed at	7
Principal triangles in which all three angles were observed	9
„ „ „ two angles were observed	6
Secondary triangles in which all three angles were observed	4
„ „ „ „ two angles were observed	23
Average triangular error in seconds	3·41
Stations and points the heights of which have been determined	25
Mean coefficient of refraction	0·055
Area of triangulation in square miles	1020
Length of series in miles	50
Station pillars built	2
Station platforms constructed	9
Hill tops cleared of jungle	7

DRAWING OFFICE, CALCUTTA.

SECTION 1.—GEOGRAPHICAL, DRAWING, AND COMPILATION.

Statement showing the work performed during the year 1897-98.

Title.	Scale.	Number of Sheets.	Remarks.
ATLAS OF INDIA.	In. M.		
Sheets Nos. 10 N.E., 14, 29, 30, 31 N.E., 31 N.W., 40, 48 N.W., 48 S.W., 53 S.E., 62, 66 S.E., 66 S.W., 67 N.E., 67 S.W., 71 S.W., 89, 90 N.W., 91 N.W., 95 N.W., 104, 100 113, 126 S.W. and 130 S.W.	1=4	25	Additions made to railways, roads, canals, and changes to boundaries.
Sheets Nos. 31 N.W., 40 S.E. 41 N.E., 41 N.W., 41 S.W., 4 N.E., 42 N.W., 47 N.E., 4 S.E., 47 N.W., 48 N.E., 57 S.W., 58 S.E., 58 S.W., 59 N.E., 59 S.E., 59 N.W. 62 N.E., 78 N.E., 78 S.E. 79 N.E., 79 S.E., 80 N.E., 80 N.W., 80 S.W., 127 N.W., 142 N.E., 142 N.W., 142 S.W., 143 N.W., 144 N.E., 144 S.E., 144 N.W., 144 S.W., 145 N.E., 145 S.E., 157 N.E., 157 S.E., 163 S.W., 164 N.E., 164 N.W., 164 S.W., 165 N.W. and 165 S.E.	1=4	44	Additions made to names and details for engraving.
Sheets Nos. 14 N.E., 14 S.E., 24 S.E., 25 N.E., 48 N.E., 59 N.W., 77 S.W., and 78 N.W.	1=4	8	Hills brush shaded for engraving.
GENERAL MAPS.			
Afghánistán (Photo.)	1= 24	2	Additions to date.
India (showing canals) (Photo.)	1= 32	6	Ditto ditto.
Do.	1= 32	6	Compilation in progress for engraving.
Do. (Skeleton) (Litho.)	1= 32	6	Railways to date.
Do. (2nd edition) (do.)	1= 32	6	Additions to date and published.
Do. (showing railways) (do.)	1= 48	6	Ditto ditto.
Do. (3rd edition) (Litho.)	1= 32	6	Under publication.
Do. (engraved)	1=128	1	Additions to date.
Do. (do.)	1=256	1	Railways and boundaries to date.
PROVINCIAL MAPS.			
Assam (Skeleton) (Litho.)	1=16	1	Additions to date.
Do. (do.)	1=16	1	Ditto to railways to date.
Do. (engraved)	1=16	1	Ditto ditto.
Bengal, Bihar, Orissa and Chota Nágpur (Litho.)	1=16	2	Additions to date and published.
Do. do.	1=16	2	Hills brush-shaded for engraving.
Do. do. (Skeleton) (Photo.)	1=16	2	Additions to date and published.
Burma and Adjacent Countries (Photo.)	1=32	2	Ditto ditto.
Do. do. (do.)	1=48	1	Ditto ditto.
Central Provinces (Litho.)	1=16	2	Additions to date.
Gujarát (engraved)	1=16	1	Completed and published.
Madras	1=16	4	Additions to date for engraving.
Nizám's Dominions and Assigned Districts of Berar (Litho.)	1=16	2	Ditto to date.
Punjab	1=16	4	Ditto ditto for engraving.
Punjab (Skeleton) (Litho.)	1=16	4	Ditto to railways to date.
Rájputána Agency (do.)	1=16	2	Ditto to date.
Upper Burma (2nd edition) (Photo.)	1=16	2	Do. to railways, boundaries and names to date.
Upper Burma (3rd edition)	1=16	2	Compilation in progress.
DIVISIONAL MAP.			
Tenasserim (Photo.)	1=4	6	Additions to date and published.

DRAWING OFFICE, CALCUTTA.

SECTION I—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
DISTRICT MAPS.	In. M.		
ASSAM—			
Darrang	1=4	1	Additions to date.
BENGAL—			
Backergunge, Bogra, Champáran, Darbhanga, Dinájpur, Monghyr, Nadia, and Palámau	1=4	8	Completed and published.
Chittagong, Jalpáiguri, and Midnapore . . .	1=4	3	Additions and corrections to date.
Puri	1=4	1	Railways to date.
PUNJAB—			
Hissar	1=4	1	Railways to date.
Jhelum (in 4 sections) . .	1=1	4	Ditto.
Ráwalpindi in 4 sections) .	1=1	4	Completed and published.
Jhelum and Ráwalpindi .	1=4	2	Additions an corrections to date.
STANDARD MAPS.			
BENGAL—			
Sheets Nos. 74, 125 and 126 .	1=1	3	Completed and published.
BOMBAY—			
Sheets Nos. 199 N.E., 199 S.E.	2=1	2	Completed and published.
CENTRAL INDIA AND RÁJPUTÁNA—			
Sheets Nos. 213, 304, 312, 381, 441, 459 and 472 . .	1=1	7	Completed and published.
Sheets Nos. 307, 408 and 474 .	1=1	3	In progress.
CENTRAL PROVINCES—			
Sheets Nos. 35, 39, 50 and 154	1=1	4	Completed and published.
Sheets Nos. 18, 20, 28 and 67	1=1	4	In progress.
HYDERABAD—			
Sheet No. 168 . . .	1=1	1	Completed and published.
NORTH-WEST TRANS-FRONTIER—			
Sheet No. 28 S.E. . .	1=4	1	Additions to date and published.
PUNJAB—			
Sheet No. 54	1=1	1	Completed and published.
Parts of sheets Nos. 28 and 53 and 55 and 83 . . .	1=1	2	Additions and corrections to date.
UPPER BURMA—			
Sheet No. 306 . . .	1=1	1	Additions and corrections to date and published.
Sheet No. 260 (2nd edition) .	1=1	1	Completed and under publication.
Sheets Nos. 314 and 359 .	1=1	2	Ditto and published.

DRAWING OFFICE, CALCUTTA.

SECTION I—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
	In. M.		
STANDARD MAPS—*concld.*			
UPPER BURMA—			
Sheet No. 316 . . .	1=1	1	In progress.
NORTH-EASTERN FRONTIER SERIES—			
Sheet No. 15 N.E. (3rd edition)	1=4	1	Corrections to date and published.
Sheet No. 15 (4th edition) .	1=8	1	Boundaries brought up to date.
Sheet No. 23 N. W. (8th edition)	1=4	1	Brought up to date and published.
Sheet No. 23 S. W. (8th edition)	1=4	1	Boundaries brought up to date.
Sheet No. 23 S.E. (2nd edition)	1=4	1	Brought up to date and published.
Parts of Sheets Nos. 23 N. E. and N. W. . . .	1=4	1	Additions to date.
Sheet No. 23 (2nd edition) .	1=8	1	In progress.
SOUTH-EASTERN FRONTIER SERIES—			
Sheet No. 1 N. E. (6th edition)	1=4	1	Additions to date and published.
Sheet No. 1 N. W. (5th edition)	1=4	1	Ditto ditto.
Sheet No. 1 S. W. (4th edition)	1=4	1	Boundaries to date.
Sheet No. 1 (5th edition) .	1=8	1	Completed and published.
Sheet No. 2 S. E. (5th edition)	1=4	1	Published.
Sheets Nos. 2 N. W. (2nd edition) and 2 S. W. (2nd edition)	1=4	2	Ditto.
Sheet No. 2 N. E. (7th edition)	1=4	1	In progress.
Sheets Nos. 3 S. E. and 3 A. N. E. . . .	1=4	2	Ditto.
Sheet No. 4 (2nd edition) .	1=8	1	Ditto.
Sheet No. 5 S. W. (6th edition)	1=4	1	Boundaries to date.
Sheet No. 5 N. W. (5th edition)	1=4	1	Completed and published.
Sheet No. 5	1=8	1	In progress.
Sheet No. 6 N. W. (7th edition)	1=4	1	Boundaries to date.
Sheet No. 6 (2nd edition) .	1=8	1	In progress.
Sheet No. 8 (2nd edition) .	1=8	1	Ditto.
ADMINISTRATION REPORT MAPS.			
Assam	1=48	1	Hills brush shaded for engraving.
Punjab	1=32	1	Corrections to date.
Upper Burma . . .	1=64	1	Completed and published.
BENGAL—			
Burdwan . . . . . Dacca . . . . . . Jalpáiguri . . . . . Noákháli	1=8	4	Additions and corrections to date.
Bogra	1=8	1	Published.
Cuttack	1=8	1	Completed and published.
Hazáribágh	1=8	1	Published.
Monghyr	1=8	1	Completed and published.
Mymensingh . . .	1=8	1	Ditto ditto.
Rájsháhi	1=8	1	Ditto ditto.
CENTRAL PROVINCES—			
Bálághát	1=8	1	Brought up to date and published.
Bastar	1=16	1	Completed and published.
Bhandára	1=8	1	Ditto ditto.
Biláspur	1=16	1	Ditto ditto.
Chindwára	1=8	1	Hills brush shaded for engraving.
Hoshangabad	1=12	1	Additions to date.
Nimár	1=8	1	Additions to date.

DRAWING OFFICE, CALCUTTA.

SECTION I—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
	In. M.		
ADMINISTRATION REPORT MAPS—*concld.*			
CENTRAL PROVINCES—*concld.*			
Saugor	1=8	1	Completed and published.
Wardha	1=8	1	Brought up to date and published.
NORTH-WESTERN PROVINCES—			
Mirzápur	1=12	1	Hills brush shaded for engraving.
PUNJAB—			
Dehra Ismáil Khán	1=16	1	Completed and published.
Delhi	1=8	1	Ditto ditto.
Gurgáon	1=8	1	Additions and corrections to date.
Hissár	1=8	1	Completed and published.
Hoshiárpur	1=8	1	Hills brush shaded for engraving.
Karnál	1=8	1	Brought up to date and published.
Ludhiána	1=16	1	Completed and published.
Montgomery	1=8	1	Ditto ditto.
INDEX MAPS.			
For Administration Report	Various.	24	Brought up to date.
Index to the standard sheets of Assam	1=24	1	Additions to railways and boundaries.
Index to the sheets of Assam, Bengal and Burma	1=16	1	Tracing made on vellum cloth.
Index to the sheets of Topographical Survey in North and South Lushai Hills	1=16	2	(a) Showing different surveys. (b) Additions to details.
Index to the standard sheets of Upper and Lower Burma	1=32	1	Additions to date.
Index to the Standard Sheets of the Punjab	1=50	1	Brought up to date.
Index to the Standard Sheets of Bengal	1=52	1	Additions and corrections to date.
Index to the Standard Sheets of Upper and Lower Burma	1=64	1	Corrections to railways and boundaries.
PLANS OF CITIES AND CANTONMENTS.			
	In. Ft.		
Sketch plan, part of Nusseerabad	1=100	1	A trace made on vellum cloth.
Plan of Solon	1=110	1	Ditto ditt .
Plan of Karáchi Cantonment	1=300	1	Ditto ditt .
Plan of Sipri Cantonment	1=500	1	Additions to date and published.
Plan of East Coast Railway (Cuttack and Puri Branch)	In. M. 1=1	1	A trace made on vellum cloth.
Plan of Simla and Jutogh	6=1	1	Published.
Plan of permanent Barrack at Mhow	6=1	1	Additions and corrections to date.
Plan of King's Bank Battery, Rangoon Cantonment	12=1	1	A trace made on vellum cloth.
Plan of Wellington Cantonment	12=1	1	Ditto ditto.
Plan of Secunderabad Cantonment	12=1	1	Ditto ditto.
Plan of Bangalore Cantonment	12=1	1	Ditto ditto.
Plan of Isthmus Cantonment, Aden	24=1	1	Ditto ditto.
Plan of Crater, Aden	24=1	1	Ditto ditto.
Plan of Steamer Point Cantonment, Aden	24=1	1	Ditto ditto.
Plans of Dagshái, Jutogh, and Subáthu Cantonments	24=1	3	Additions and corrections to date.
Plans of Forts Sandeman and Kasauli	24=1	2	Ditto ditto.
SPECIAL MAPS.			
Route from Pathánkot to Simla	1=4	2	Completed.
Map of Central Provinces	1=32	1	Corrections to date.
Map of India	1=192	1	Showing Educational progress for Quinquennial Report, 1892—97.

DRAWING OFFICE, CALCUTTA.

SECTION I—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
WORK DONE FOR OTHER DEPARTMENTS.	In. M.		
MISCELLANEOUS.			
Country 12 miles round Quetta Cantonment . . .	2=1	1	Prepared for the Military Department.
Countries 12 miles round Ajmere, Deoli, Mhow, Neemuch, Nusseerabad, and Sirdarpore Cantonments	1=1	6	Prepared for the Adjutant General Commanding the North Western Divisions.
Country 12 miles round Nimár .	1=1	1	Additions to date.
Map of Largha Shirani Country	1=1	1	A trace made on vellum cloth for Foreign Department.
Map of Simla . . .	1=4	1	Completed and published for Sir H. Collett.
Maps of Assam, Bhágalpur, Burdwan, Chittagong, Chota-Nágpur, Dacca, Orissa, Patna Presidency, and Rájsháhi Divisions	1=8	10	Prepared for the Inspector General of Registration.
Province of Assam	1=16	1	Additions to names for the High Court of Judicature.
Bengal, Bihar, Orissa and Chota Nágpur	1=32	1	Prepared for the Inspector General of Registration.
Central Provinces (illustrating Famine report)	1=32	1	Prepared for the Administrative Medical Officer, Central Provinces.
Famine Map of the Central Provinces, showing (1) Aborigines, (2) Crop outturn, (3) Death rates, (4) Forms of relief, (5) Rise of prices, (6) Village Relief	1=48	6	Ditto ditto ditto.
India (showing railways) . .	1=32	6	Under preparation for the Public Works Department.
MAPS, COLOURED, ETC.			
Maps on various scales . .	...	1,364	For Surveyor General's Office.
Ditto ditto . .	...	582	For other Departments.
TOTAL .	...	1,946	

DRAWING OFFICE, CALCUTTA.

SECTION I.—*concluded.*

Statement of work.—concluded.

Description of work.	Number of sheets.
MAPS EXAMINED.	
Atlas Sheets	84
General Maps	13
Provincial Maps	9
District Maps	2
Standard Maps	52
Plans of cities and cantonments	3
Administration Report Maps	15
Index Maps	15
Statistical and Extra Departmental Maps	55
Miscellaneous Maps	48
Triangulation Charts	1
Originals and Office copies of various maps with additions and corrections in territorial boundaries, public works, etc	670
Tracing prints prepared for Atlas Reductions	69
Tracings of roads, canals and railways from originals supplied by Public Works Department	16
Engraved proofs of Atlas Sheets in various stages	189
Ditto of General and Provincial Maps, including Index Charts	33
Ditto of large scale plans	4
Ditto of Administration Report Maps	48
Ditto of Statistical Maps	[illegible]
Litho. proofs of General and Provincial Maps including Index Charts	30
Ditto of Atlas Sheets and District Maps transferred from copper plates	23
Ditto of Statistical and Extra-Departmental Maps	7
Photo. proofs of Standard and various other maps	381
Colouring of maps for various purposes	513
Projection and examination of graticules and plotting of points	46
TOTAL	2,327

Note.—In addition to the above, many miscellaneous jobs, such as supply of geographical data to various officials, calculation of areas, computation of graticules for the projection of the sheets of the Indian Atlas, examination of the printed catalogues of maps as to additions and corrections up to date, examination of the proof sheets of the Survey of India Department Notes, and of the "General Report on the Operations of the Survey of India Department" as to the correct orthography of geographical names, and various other minor works have been performed by the Examining Section.

DRAWING OFFICE, CALCUTTA.

SECTION II.—REVENUE, DRAWING, AND COMPILATION.

Statement showing the work performed during the year 1897-98.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS.	In. M.		
PUNJAB.			
Indus Riverain Survey.			
Sheets Nos. 23, 46, 47, 48, 59, 68 and 99	1=1	7	Proofs passed, press order given.
District Peshâwar.			
Sheets Nos. 1, 2, 3, 5, 8 and 9 (old Sheets) . . .	1=1	6	Ditto ditto.
Sheets Nos. 79 and 80 . .	1=1	2	Compiled from the old sheets with additions from tracings received from the district officials; proofs passing through press.
Sheets Nos. 78 and 106 . .	1=1	2	Drawing and typing almost finished.
Sheets Nos. 51, 52, 105, 107, 108 and 134	1=1	6	Drawing and typing in progress.
District Hazára.			
Sheet No. 12	1=1	1	Proof examined with district officer's proof and sent to press for corrections.
District Hissár.			
Sheets Nos. 257, 258 and 275 .	1=1	3	Additions and corrections made to boundaries and roads.
Districts Umballa and Karnál.			
Sheets Nos. 292, 293, 294, 315 and 316	1=1	5	Ditto ditto.
District Dera Ghâzi Khán.			
Sheets Nos. 17, 18, 19, 20, 36, 37, 38, 39, 40, 41, and 42 . .	1=1	11	Corrected up to date from the 16-inch tracings received from the district officials.
District Montgomery.			
Sheet No. 198	1=1	1	Redrawn, proofs passed, and press order given.
Sheet No. 174	1=1	1	Printed map touched up, corrected and sent to press for reproduction. Proofs sent out to district officers for corrections.
NORTH-WESTERN PROVINCES AND OUDH.			
Districts Meerut and Moradabad.			
Sheet No. 31	1=1	1	Examined with district officer's proofs and returned to press for corrections.
District Saháranpur, Muzaffarnagar and Meerut.			
Sheets Nos. 2 and 4 . .	1=1	2	Additions and corrections made to roads and boundaries.
Sheet No. 13	1=1	1	Completed with village boundaries; proof passed; press order given.
Sheets Nos. 6, 15 and 16 . .	2=1	3	Completed with village boundaries; proofs returned to press for corrections.
Sheets Nos. 10, 14 and 18 . .	1=1	3	Completed with village boundaries; proofs sent out to local officers for corrections up to date.
Sheet No. 19	1=1	4	Fair maps corrected and sent to press for reduction to 1-inch scale.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS—*contd.*	In. M.		
NORTH-WESTERN PROVINCES AND OUDH—*contd.*			
District Aligarh.			
Sheets Nos. 23 and 35 . .	2=1	8	Fair maps corrected and sent to press for reduction to 1-inch scale.
Sheet No. 36	1=1	1	Additions and corrections made to boundaries and roads.
Districts Aligarh, Muttra and Agra.			
Sheets Nos. 24, 25, 37 and 38 .	1=1	4	Proofs sent to district officers for corrections up to date.
Districts Jaunpur, Benares and Mirzápur.			
Sheets Nos. 168 and 169 . .	1=1	2	Proofs returned to press for corrections.
Sheet No. 171	1=1	1	Blue and black proofs transferred to Geographical Section, Drawing Office.
Districts Gházipur, Benares and Mirzápur.			
Sheet No. 195	1=1	1	Proofs sent out to district officers for completion up to date.
Sheets Nos. 196 and 197 . .	1=1	2	Second proof returned to press for further corrections.
Districts Bastí, Gorakhpur and Gházipur.			
Sheets Nos. 175, 188, 190, 203, 205, 208, 220 and 221 . .	1=1	8	Proofs returned to press for further corrections.
Sheet No. 189	1=1	1	Proofs sent to local officers for corrections up to date.
District Bánda.			
Sheet No. 112A . . .	1=1	1	Proof transferred to Geographical Section, Drawing Office.
Districts Gorakhpur, Gházipur, Ballia and Benares.			
Sheets Nos. 209, 210, 211, 217, 218 and 219 . . .	1=1	6	Additions and corrections made to boundaries and roads.
Districts Bareilly and Pilibhít.			
Sheet No. 82	1=1	1	Ditto ditto.
Portion of Naini Tal (Kumáun Bhábar) District.			
Sheets Nos. 63 $\frac{\text{N.W.}}{\text{1 and 3, 4}}$, $\frac{\text{S.W.}}{\text{1, 2, 3, 4}}$ and 251 $\frac{\text{S.E.}}{\text{1, 3}}$ and $\frac{\text{S.W.}}{\text{1, 2, 3, 4}}$	4=1	9	Proofs passed, press order given.
Sheets Nos. 46 $\frac{\text{N.E.}}{\text{2, 4}}$, $\frac{\text{S.E.}}{\text{2}}$, 63 $\frac{\text{N.E.}}{\text{3}}$, $\frac{\text{S.E.}}{\text{1}}$, 64 $\frac{\text{N.E.}}{\text{1, 3, 4}}$, $\frac{\text{S.E.}}{\text{1, 2, 4}}$, 250 $\frac{\text{S.W}}{\text{3}}$ and 251 $\frac{\text{N.W.}}{\text{1, 2, 3, 4}}$	4=1	19	Proofs returned to press for further corrections.
Sheets Nos. 63 $\frac{\text{S.E.}}{\text{3}}$ and 64 $\frac{\text{N.E.}}{\text{2}}$	4=1	2	Proofs sent to district officers.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
STANDARD MAPS—*contd.*	In. M.		
OUDH.			
Sheet No. 136	1=1	1	Proofs sent to district officers for completion up to date.
Sheets Nos. 88, 99, 129, 130, 131, 145, 148, 158, 160, 161, 173, 174 and 175 . . .	1=1	13	Additions and corrections made to boundaries, roads, etc.
BENGAL.			
District Darjeeling (including British portion of Sikkim).			
Sheet No. 269	1=1	1	Second proof returned to press for corrections.
Sheet No. 270	1=1	1	Proof corrected from district officer's copies, and returned to press for corrections.
Districts Hooghly and Howrah.			
Sheets Nos. 263, 264, 265, (285 and portion of 308), 285, 286, 287 and (288 and portion of 239)	2=1	21	Spelling of names of fair sheets being corrected to Hunterian system and sites altered into blocks for republication.
District Midnapore.			
Sheets Nos 3, 6 and 9 . .	1=1	3	Additions and corrections made to boundaries and roads.
District Mymensingh.			
Sheet No. 389	1=1	1	Proof examined and corrected up to date.
Sheets Nos. 347 and 343 . .	1=1	2	Proofs sent to press for corrections.
Districts Puri and Balasore.			
Sheets Nos. 138 and 248 . .	1=1	2	Additions and corrections made to boundaries and roads.
ASSAM.			
District Cachar.			
Sheets Nos. 68 and 69 . .	1=1	2	Second proofs returned to press for corrections.
BOMBAY.			
Sheets Nos. 192, 206 and 301 .	1=1	3	Second proofs returned to press for further corrections.
Sheets Nos. 164, 183, 201, 231 and 232	1=1	5	Proofs returned to press for corrections.
Sheet No. 349	1=1	1	Proof passed, press order given.
Sheets Nos. 195, 328, 350, and 351	1=1	4	Proofs sent to district officers for correction up to date.
Sheets Nos. 233, 239, 240, 272 and 273	1=1	5	Additions and corrections made to boundaries and roads.
District Thána.			
Sheets Nos. 133 $\frac{\text{S.E.}}{1, 2, 3, 4}$, 134 $\frac{\text{N.E.}}{1, 2, 3, 4}$ and $\frac{\text{S.E.}}{1, 2, 3, 4}$.	4=1	12	Proofs corrected from district officer's copies.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of sheets.	REMARKS.
STANDARD MAPS—*concld.*	In. M.		
LOWER BURMA.			
Sheets Nos. 282, 371, 374, 476 and 477	1=1	5	Proofs passed; press order given.
Sheets Nos. 421 and 422 . .	1=1	2	Second proofs returned to press for corrections.
Sheet No. 179	1=1	1	Proof sent to district officer for further reference.
District Tavoy.			
Sheet No. 487	2=1	4	Completed and being examined.
Sheets Nos. 488 and 489 . .	2=1	8	Drawing and typing completed.
Sheet No. 486	2=1	4	Fair maps examined with 16-inch plans corrected and sent to press for reduction to 1-inch scale.
UPPER BURMA.			
District Minbu.			
Sheets Nos. 89, 90 and 130 .	1=1	3	Proofs passed; press order given.
Sheets Nos. 127, 128 and 129 .	1=1	3	Second proofs being examined.
Sheets Nos. 174 and 175 . .	1=1	2	Proofs sent to district officers.
District Kyauksè.			
Sheets Nos. 263 and 264 . .	2=1	6	Fair maps being corrected from informations supplied by local officers.
PARGANA MAPS.			
District Bánkura.			
Main Circuit Nos. 17 and 18 .	1=1	2	Printed maps touched up, corrected and sent to press for reproduction; proofs passed; press order given.
GANGES DIÁRA SURVEY.			
Main Circuit Nos. 1, 2, 3 and 4 .	1=1	2	Ditto ditto.
District Mánbhúm.			
Main Circuit No. 2 . . .	1=1	1	Ditto ditto.
District Mymensingh.			
Main Circuit Nos. 2, 6, 23, (34, 35, 36) and (43 and 44) . .	1=1	6	Ditto ditto.
District Nadia.			
Sheets Nos. 1, 2, 4, 6 and 7 . .	1=1	5	Additions and corrections made to boundaries and roads.
District Pabna.			
Main Circuit No. 4	1=1	1	Printed maps touched up, corrected and sent to press for reproduction, proof passed, press order given.
District Sháhabad.			
Sheets Nos. 6, 9 and 10 . .	1=1	3	Ditto ditto.
District Sylhet.			
Sheets Nos. 1 to 11 . . .	1=1	11	Ditto ditto.
District Tippera.			
Main Circuit Nos. 1 to 10 .	1=1	10	Additions and corrections made to boundaries and roads.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
PARGANA MAPS—*concld.*			
District 24-Parganás.	In. M.		
Sheets Nos. 3, 4, 5 and 6 . .	1=1	4	Printed maps touched up, corrected and sent to press for reproduction; proofs passed, press order given.
Sheets Nos. 1 and 2 . .	1=1	2	Ditto, proofs corrected and sent to press.
DIHI PANCHÁNNAGRÁM.			
Grand Division 1, Sub-Division 3	99 ft. = 1 inch	1	Printed maps touched up, corrected and sent to press for reproduction; proofs passed, press order given.
Grand Division 2, Sub-Division 9, Sections 1 and 2 . .		2	
Grand Division 3, Sub-Division 23, Section 2		1	
Grand Division 5, Sub-Division 5, Section 2		1	
Grand Division 6, Sub-Division A		1	
Ditto ditto 7, Section 1		1	
Grand Division 6, Sub-Division Q 2nd		1	
CENTRAL PROVINCES.			
District Bhandára.			
Main Circuits Nos. 3, 5, 6, 8 and 12	1=1	5	Additions and corrections made to boundaries and roads.
District Jubbulpore.			
Main Circuit No. 16, portion of 17 (19, 20 and 21) . .	1=1	2	Printed maps touched up, corrected and sent to press for reproduction; proofs passed, press order given.
DISTRICT MAPS.			
PUNJAB.			
Gujránwála	1=2	2	Additions and corrections made to roads, boundaries, etc.
Mooltan	1=2	2	Ditto ditto.
Siálkot (skeleton) . . .	1=4	1	Proofs passed, press order given.
NORTH-WESTERN PROVINCES AND OUDH.			
Jhánsi	1=2	2	Printed maps touched up, corrected and sent to press for corrections; proofs passed, press order given.
BENGAL.			
Noákháli	1=4	1	Additions and corrections made to roads, boundaries.
Chittagong	1=4	1	
ASSAM.			
Sylhet	1=4	1	Ditto ditto.
CENTRAL PROVINCES.			
Nágpur and Wardha . .	1=2	4	Ditto ditto.
Saugor	1=2	6	Further corrections and additions made to boundaries, etc., from the tracings received from Settlement Officers.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

TITLE.	Scale.	Number of Sheets.	REMARKS.
PLANS OF CITIES AND CANTONMENTS.	In. M.		
Hubli	8=1	2	Proofs passed, press order given.
Devláli	12=1	1	Additions and corrections made to roads, etc.
Ráwalpindi	6=1	2	
Ferozepore	6=1	4	
Jullundur	6=1	6	
Mooltan	6=1	2	
Bareilly	16=1	21	Originals sent to press for reduction to 6-inch scale.
Cawnpore	12=1	9	Proofs corrected up to date from local officer's proofs.
Lucknow	6=1	4	Ditto ditto.
Allahabad	6=1	6	Proofs returned to local officers for further reference.
Meerut	12=1	16	Additions and corrections made to roads, etc.
Siálkot	8=1	16	Ditto ditto.
Meean Meer	6=1	6	Ditto ditto.
Jubbuloore	8=1	2	Proofs passed, press order given.
Ditto, Topo-portion	8=1	1	Printed maps corrected and sent to press for re-production; proofs passed, press order given.
Kamptee	8=1	4	Additions and corrections made to roads, etc.
Calcutta and Suburbs	6=1	2	Completed from the materials of the last survey and drawn to scale, typing in progress.
Dacca	8=1	2	Printed maps corrected and sent to press for re-production; proofs passed, press order given.
Moulmein Town	50 feet =1	41 to 50	Proofs passed, press order given.
Ditto	50 feet =1	51 to 69	Proofs sent to press for correction.
Ditto	400 feet =1	8	Proofs passed, press order given.
Rangoon Town	50 feet =1	51	Original sent to press for reproduction.
MISCELLANEOUS MAPS.			
Naiháti Municipality	4=1	2	Drawn and sent to local officer for further correction.
Nahan Estate	...	...	Compiled for reduction to ¼-inch scale.
Calcutta and surrounding country	1=1	3	One sheet on the north compiled from 1-inch sheets, and the two old sheets corrected up to date. Proofs passed, press order given.
Reference of Rangoon sheets	...	1	Redrawn for reduction and sent to press, proofs passed.
Alphabetical list of villages of District Hoshiárpur, in English and Urdu	...	2	Proofs passed, press order given.
TRIANGULATION CHART.			
GUJARÁT SURVEY.			
Degree Sheets Nos. 10 and 14	1=4	2	Proofs sent to press for corrections.
INDEX MAPS.			
Moulmein Town	...	1	Proofs passed, press order given.
Rangoon Town	1,250 ft. =1	2	Ditto ditto.
Ditto	2,500 ft. =1	1	Ditto ditto.
For Administration Report	Various	2	Drawn and sent to press.
Ditto ditto	"	12	Corrected to 1898 and sent to press.
TRACINGS ON CLOTH.			
Tracings of sheets	"	86	These tracings and plans have been prepared for Government officials and other departments.
Village plans	"	49	
Maps coloured	"	50	For Office use.
Ditto	"	11,427	Colouring examined for stock in M. R. I. O.

DRAWING OFFICE, CALCUTTA.

SECTION II—*continued.*

Statement of work—continued.

DESCRIPTION OF WORK.	REMARKS.
Computations examined.	
District Amherst 1889—95 (6 seasons).	
" Palámau 1892—95 (3 seasons).	
Traverse data, etc., supplied.	
Traverse of Districts Purnea and Bhágalpur along Nepál (4 pages).	To Superintendent, Settlement Surveys, Bengal.
Traverse of District Kheri along Nepál (4 pages)	To Superintendent, Forest Surveys.
" of Captain Anderson's Survey of Oudh and Nepál Boundary (11 pages).	To O. C. Nos. 2 and 8 Parties.
Traverse of Lieutenant-Colonel Macdonald's Survey of Bhután Boundary along Districts Kámrúp and Darrang of Assam (10 pages).	To O. C. No. 6 Party.
Traverse of Nepál and Purnea and Bhágalpur Boundary.	To Resident, Nepál.
Traverse of District Budaun along District Farukhabad (6 pages).	To O. C. Nos. 2 and 8 Parties.
Traverse of District Ballia, Gházipur, Jaunpur and Gorakhpur along District Azamgarh (45 pages).	Ditto ditto.
Traverse of District Tarái along District Pilibhít (2 pages).	Ditto ditto.
Traverse of District Agra along District Etáwah	Ditto ditto.
" of District Agra along District Etah with connections to G. T. Stations and co-ordinates calculated from the origin of survey (8 pages).	Ditto ditto.
Traverse of District Agra along Districts Mainpuri and Etáwah and the Gwalior State (15 pages).	Ditto ditto.
Traverse of District Etah along District Mainpuri with co-ordinates calculated from the origin of survey (5 pages).	Ditto ditto.
Traverse of District Darjeeling along Cart Road (15 pages).	To Under Secretary, Government of India, P. W. D.
Traverse of District Sylhet along Hill Tippera (55 pages).	To Deputy Commissioner, Sylhet.
Traverse of Sylhet Frontier Circuit (3 pages)	Ditto ditto.
" of District Seoni with co-ordinates calculated from the origin of survey (33 pages).	To Superintendent, Forest Surveys.
Traverse of Districts Sagaing and Kyauksè along District Myingyan (23 pages).	To O. C. No. 3 Party.
Traverse of District Gurdáspur along District Kángra	" O. C. No 18 Party.
Supplied Village Traverses (237 pages).	" Public Officers.
Field Book of Lieutenant-Colonel Macdonald's survey of Bhután and Assam Boundary with co-ordinates of *pucka* pillars and their description (49 pages).	" O. C. No. 6 Party.
Tables of co-ordinates of Prome Villages (48 pages)	" Commissioner, Pegu Division.
Latitudes and longitudes of stations of Balúchistán Series.	" O. C. No. 12 Party.
Lists of Villages of *Pargana* Shergarh, District Burdwan (21 pages).	" Superintendent, Settlement Surveys, Bengal.
Miscellaneous.	
Calculated latitudes and longitudes and direct distances of certain triangulated stations in District Nimár, also latitudes and longitudes of triangulated stations in District Hoshangabad, and plotted the same for incorporation of Revenue Survey portion into Topographical Survey degree sheet.	

DRAWING OFFICE, CALCUTTA.

SECTION II—*concluded.*

Statement of work—concluded.

DESCRIPTION OF WORK.	REMARKS.
Miscellaneous—concluded. Calculated bearings and distances of certain Hooghly River Survey points for the Superintendent, Marine Surveys. Calculated bearings and distances of *pucka* pillars on the Nepál and Sarda River boundary, also of *pucka* pillars on the Nepál and Rohilkhand boundary with latitudes and longitudes of stations from the origin, Bhugora Tál. Set up and proved a Traverse of Nepál and Oudh boundary from the Field Book of Captain Anderson's Survey of 1859-60 for Office record. Prepared a statement of Village areas of Pataspur Estate, District Midnapore. Prepared and supplied area statements of districts Dera Gházi Khán, Dera Ismáil Khán and Bannu. Calculated areas by *parganas* and *tahsils* of District Hazára; also of sheets Nos. 165 and 232 Bombay. Prepared another statement showing the areas of all the districts in the North-Western Provinces and Oudh. Computation and plotting of two groups of villages of District Nadia for preparation of congregated village maps. Calculated co-ordinates from one common origin of all trijunctions of villages in sheets Nos. 179 and 181, districts Prome, Tharrawaddy and Henzada, and plotted the same for filling in Topographical operations of the hilly and forest portions in those sheets. Prepared Summary of Outturn Statement, also statement of cost-rates for General Report. Checked annual statements received from Executive officers.	

DRAWING OFFICE, CALCUTTA.

SECTION III.—CADASTRAL.

State of publication of Cadastral Maps on the 30th September 1898.

Districts.	Number of Sheets.							Remarks.
	Maps received.			Maps published.				
	Up to 30th September 1897.	Added during past 12 months.	Total up to 30th September 1898.	Up to 30th September 1897.	By Surveyor General's Office during past 12 months.	Total to 30th September 1898.	Remaining to be published.	
North-West Provinces.								
Agra	2,942	...	2,942	2,942	...	2,942	...	
Azamgarh	930	...	930	930	...	930	...	
Ballia	1,601	...	1,601	1,601	...	1,601	...	
Bánda	3,317	...	3,317	3,317	...	3,317	...	
Basti	5,571	...	5,571	5,571	...	5,571	...	
Benares	2,052	...	2,052	2,052	...	2,052	...	
Bijnor	31	...	31	31	...	31	...	
Dehra Dún	701	...	701	701	...	701	...	
Fyzabad	14	...	14	14	...	14	...	
Garhwál	9,100	...	9,100	5,161	3,306	8,467	633	
Gházipur	4,021	...	4,021	4,021	...	4,021	...	
Gorakhpur	8,615	...	8,615	8,615	...	8,615	...	
Hamírpur	2,926	...	2,926	2,926	...	2,926	...	
Jaunpur	3,583	...	3,583	3,583	...	3,583	...	
Jhánsi	1,661	...	1,661	1,661	...	1,661	...	
Kumáun (Bhábar)	332	...	332	332	...	332	...	
Morádabad and Tarái	4,023	...	4,023	4,023	...	4,023	...	
Muttra	1,658	...	1,658	1,658	...	1,658	...	
Mirzápur	3,794	...	3,794	3,794	...	3,794	...	
Rámpur State	1,356	...	1,356	1,356	...	1,356	...	
Tarái	862	...	862	862	...	862	...	
Totals	59,090	...	59,090	59,090	3,306	58,457	633	
Burma.								
Akyab	2,785	...	2,785	2,785	...	2,785	...	
Amherst	3,664	...	3,664	3,664	...	3,664	...	
Bassein	3,437	...	3,437	3,437	...	3,437	...	
Hanthawaddy and Pegu	4,601	...	4,601	4,601	...	4,601	...	
Henzada	1,391	...	1,391	1,391	...	1,391	...	
Katha	56	228	284(*a*)	...	235	235	49	
Kyauksè	801	13	814(*a*)	801	13	814	...	(*a*) These figures are liable to alteration until publication has been completed.
Magwe	...	1,024	1,024(*a*)	...	38	38	986	
Mandalay	781	11	792(*a*)	781	11	792	...	
Meiktila	1,861	13	1,874(*a*)	1,369	505	1,874	...	
Mergui	1,071	...	1,071	1,071	...	1,071	...	
Minbu	1,447	...	1,447	1,447	...	1,447	...	
Pegu	...	519	519(*a*)	...	135	135	384	
Prome	847	...	847	847	...	847	...	
Rangoon Town and Index	20	...	20	20	...	20	...	
Sagaing	2,286	...	2,286	1,714	83	1,797	489	
Tavoy	763	...	763	763	...	763	...	
Tharrawaddy	1,363	...	1,363	1,363	...	1,363	...	
Thatón	1,200	...	1,200	1,106	94	1,200	...	
Thôngwa	3,749	...	3,749	3,749	...	3,749	...	
Totals	32,123	1,808	33,931	30,909	1,114	32,023	1,908	
Bengal and Orissa.								
Backergunge	261	...	261	261	...	261	...	
Cuttack Town	86	...	86	86	...	86	...	
Muzaffarpur	1	...	1	1	...	1	...	
Patna and Gaya	3,054	...	3,054	3,054	...	3,054	...	
Puri (Khurda Estate)	4,565	...	4,565	4,565	...	4,565	...	
Sháhabad	4,924	...	4,924	4,924	...	4,924	...	
Totals	12,891	...	12,891	12,891	...	12,891	...	
Assam.								
Cachar	191	304	495(*a*)	120	311	431	64	
Darrang	1,074	...	1,074	1,074	...	1,074	...	
Kámrúp	2,218	...	2,218	2,210	...	2,210(*b*)	8(*c*)	(*b*) Exclusive of 5 sheets reprinted.
Lakhimpur	346	...	346	346	...	346	...	
Nowgong	1,277	...	1,277	1,277	...	1,277	...	
Sibságar	2,050	...	2,050	2,042	...	2,042	8(*c*)	(*c*) These are not to be printed.
Sylhet	213	...	213	168	...	168	45(*c*)	
Sylhet (Jaintia)	651	...	651	651	...	651	...	
Totals	8,020	304	8,324	7,888	311	8,199	125	
Central Provinces.								
Ráipur	43	...	43	43	...	43	...	
Totals	43	...	43	43	...	43	...	
GRAND TOTALS	112,167	2,112	114,279	106,882	4,731	111,613	2,666	

Abstract of work performed during 1897-98.

Provinces.	Number of Sheets.				Remarks.
	Examined and rendered suitable for Photo-Zincography.	Traced and examined for Zincography.	Proof sheets examined previous to press order.	Coloured and subsequently examined.	
North-West Provinces	2,796	668	3,357	......	32 inches = 1 mile.
Burma	1,103	364	1,132	......	16 ,, = 1 ,,
Assam	223	122	311	......	16 ,, = 1 ,,
Totals	4,122	1,154	4,800	......	

DRAWING OFFICE, CALCUTTA.

SECTION IV.—BENGAL PROVINCIAL.

Statement showing progress of 2-inch mapping during 1897-98.

Provinces.	Total number of sheets.	Graticules projected.	Stations p'ot ed.	Details reduced by Pentagraph and transferred to 2-inch sheets.	Number of villages, streams etc., typed.	Outlining completed.	Footnotes, margin, etc. completed.	Examined.	Finally examined.	Sent to Photographic office for reduction to 1-inch scale.	Proofs examined.	Final press order given.	Remarks.
Orissa.													
Previously reported . .	124	124	121	114	114	114	114	114	114	88	88	12	
Completed during the year, including Khurda.	...	...	3	10	10	4	...	...	...	...	...	...	
Total to 30th September 1898	124	124	124	124	124	118	114	114	114	88	88	12	
Bihar.													
Previously reported . .	116	67	59	33	28	24	...	...	...	...	...	...	
Completed during the year	8	51	59	71	64	44	40	56	16	16	...	...	

ENGRAVING OFFICE, CALCUTTA.

Statement showing the work performed during the year 1897-98.

Title of Map.	Number of plates.	Outline, square inches.	Number of letters cut.	Hills, sand, lakes, square inches.	Remarks.
Atlas of India.					
Scale 1 inch=4 miles.					
Quarter sheets, new, completed	6	59	4,983	53	
Ditto „ in progress	65	1,540	81,106	540	
Additions and corrections to published quarter sheets	63	336	19,414	38	
Ditto ditto full sheets	26	381	48,672	249	
New plates projected, etc., (Atlas sheets)	25	33	4,665	...	
General Maps.					
On various scales	6	32	8,818	3	
Provincial Maps.					
On scales 1 inch=16 and 32 miles	19	248	72,210	156	
On various scales for Administration Reports	2	4	160	...	
District Maps.					
On various scales for Administration Reports	35	407	25,125	173	
Plans	5	42	8,691	16	
Charts	7	22	14,232	64	
Miscellaneous plates	51	...	30,074	580	
Total	310	3,104	318,150	1,872	

Copper-plate Printing.

Impressions taken	24,972
Proofs pulled	483
Transfers pulled	516
Total	25,971

Steel Facing.

Double elephant plates, steel faced	29
Ditto „ removed	15
Atlas sheets „ faced	113
Ditto „ removed	43
Miscellaneous plates „ faced	26
Ditto „ removed	19
Total	245

PHOTOGRAPHIC AND LITHOGRAPHIC OFFICE, CALCUTTA.

Extract from the Narrative Report of Mr. T A. Pope, Assistant Surveyor-General, Season 1897-98.

OUTTURN.—The outturn of work performed in the Photographic and Lithographic Office during the past year is satisfactory, each section having been kept fully employed throughout the year. Estimated by the number of pulls from stone and zinc the outturn is about the same as last year. The total number of printed copies is, however, again less, which seems to be due to the fact that the number of copies of maps and plans indented for by Government officials is gradually becoming smaller, and there is probably less unnecessary printing and consequent waste of labour and material than was formerly the case. The outturn of work in each section is given in full detail in the annexed statements.

ORIGINAL SUBJECTS.—The total number of original subjects received and taken in hand for reproduction during the year was 6,364, as against 7,880 last year. The falling off is principally due to the comparatively small number of cadastral maps sent in for reproduction, about 1,100 less than last year. There is a slight decrease also in the number of departmental maps received, while the number of extra-departmental subjects remains about the same as last year.

The number of subjects lithographed was 524 (58 departmental and 466 extra-departmental), or 88 less than last year. The remaining 5,840 subjects were reproduced by various photographic processes or zincographed, and include 727 departmental maps, etc., 4,477 cadastral maps, and 636 extra-departmental subjects. The actual number of maps, etc., received during the year was 6,391 (862 departmental, 4,294 cadastral, and 1,235 extra-departmental). The number completed and despatched was 6,187 (519 departmental, 4,766 cadastral, and 902 extra-departmental).

LITHOGRAPHIC DRAWING SECTION.—The total number of new subjects drawn on transfer paper or stone, or of additions and corrections made to work already on stone, during the year was 650, of which 54 were departmental and 596 extra-departmental. Last year, the number was 515 (26 departmental and 489 extra-departmental). The section was somewhat handicapped by the retirement on pension of two of the senior native draftsmen and the death of a promising junior hand. One or two young hands were taken on as apprentice draftsmen and are making good progress under Mr. Fogarty's training. Mr. Fogarty was in charge of the section throughout the year, and has again shown much ability in arranging for the speedy and methodical completion of the large mass of work passing through his hands, and in supervising and training the staff of draftsmen under him.

LITHOGRAPHIC PRINTING SECTION.—The number of subjects printed from stone was 524, or 88 less than last year. Of these, 58 were departmental and 466 extra-departmental, as against 56 departmental and 556 extra-departmental last year. The number of pulls from stone was 547,497, of which 95,716 were departmental and 451,781 extra-departmental. The total number of copies printed from stone was 402, 906 (87,728, departmental and 315,178 extra-departmental). The work of the section was carried on as usual by Sergeant Vandyke, R.E., under Mr. Fogarty's supervision, to my entire satisfaction. Sergeant Vandyke's practical knowledge of steam-printing machinery was turned to good account on the arrival of the new double-demy litho. and zinc printing machine received from England in June last, as he undertook to set it up himself and did so successfully in much less time and at considerably less cost than such work has been done for us on previous occasions by the Public Works Department.

ZINC-PRINTING SECTION (NORMAL).—The number of zinc plates printed during the year was 917, of which 339 were departmental and 578 extra-departmental. The number of pulls was 194,535, of which 65,537 were departmental and 128,998 extra-departmental, and of complete copies 198,578 (68,427 departmental and 130,151 extra-departmental). Last year, the corresponding figures were as follows:—Number of zinc plates printed, 1,104 (509 departmental and 595 extra-departmental); number of pulls 148,003 (87,818 departmental and 60,185 extra-departmental); number of copies 175,254 (84,957 departmental and 90,297 extra-departmental). The amount of printing done during the year under report thus shows a large increase over last year, though the number of plates printed from is less. Mr. E. A. Lefranc continued in charge of the section throughout the year, except for a period of two months and a half while he was absent on privilege leave owing to ill health. Mr. Lefranc's duties are arduous, and he is much to be commended for remaining at his post during the hot weather, though he was really ill at the time, and for the efficient manner in which he has managed the work of the section generally.

ZINC-PRINTING SECTION (CADASTRAL).—There has been a considerable reduction in the number of cadastral sheets received during the year, due in part to the injury done to the office of No. 6 Party at Shillong by the earthquake in June 1897, when a considerable number of Assam cadastral sheets which should have been reproduced this year were seriously damaged and could not be sent in. The number of plates of cadastral maps of Burma, Assam and the North-Western Provinces printed off was 4,649, the number of pulls being 103,530, and of copies of complete villages 94,328. Last year, 5,645 plates were printed, the pulls being 133,223, and copies 122,293. Mr. J. B. McKenzie continued in charge of the section and managed the work very efficiently. He held

charge of the Normal section during Mr. Lefranc's absence in June, July and August, and Mr. P. Michael officiated in charge of the Cadastral section.

TYPE-PRINTING SECTION.—The type-printing work shows a large increase during the year. The number of pages or items set up was 13,819, as against 10,054 last year; the number of pulls was 1,176,837 and of copies 700,756, against 931,543 pulls and 529,664 copies last year. Mr. E. DePyvah continued in charge and worked well.

NEGATIVE SECTION.—The number of negatives and transparencies taken during the year amounted to 5,242, as against 6,272 in the previous year, the deficiency being due to the smaller number of cadastral sheets dealt with. This number includes 70 direct and 16 reversed negatives taken on dry plates, and 113 transparencies made in the Heliogravure section. One thousand and eighty-one negatives were of departmental maps, etc., 3,288 of cadastral maps, and 873 of extra-departmental maps, plans, etc. The processes employed underwent no change, but successful efforts were made by Mr. Haward to reduce the expenditure of the more expensive reagents employed, and to prevent waste. Mr. Haward was in charge throughout the year. As Head Assistant of the Photographic Branch he also exercised general supervision over all the photographic sections, except the Heliogravure section, from the beginning of the year, and showed himself quite competent to exercise the increased responsibility thus imposed upon him.

PHOTO-TRANSFER PRINTING SECTION.—The number of photo-transfer prints made during the year was 5,161, against 5,794 made last year, the defect being, as in the case of the negatives, due to the reduction in the number of cadastral sheets received. Of the 5,161 transfers, 1,152 were of departmental maps, etc., 3,443 of cadastral maps, and 566 of extra-departmental subjects. Mr. J. Harrold, who had been in charge of this section for many years, retired on pension in May 1898, and his place was taken by Mr. R. George who had been acting as Store-keeper. Both Messrs. Harrold and George performed their duties efficiently, and the loss of the services of the former Assistant is much regretted.

SILVER-PRINTING SECTION.—The number of blue, or cyanotype, prints made during the year was 2,174, and of silver prints 283. Last year, the outturn was 3,267 blue prints and 354 silver prints.

During April 1898, experiments with the gum-bichromate printing process were carried out in this section, and though promising results were obtained, it does not seem to possess any great advantages over the Moss plain paper process introduced by Colonel Waterhouse some years ago. Moreover, the process is difficult to work and takes too much time. It might perhaps prove suitable for copying crayon drawings and similar subjects. Further experiments may be made with it hereafter when time permits. Mr. C. J. Meade continued in charge of the section, and, as usual, performed his duties in a careful and painstaking manner.

HELIOGRAVURE SECTION.—The outturn of work in this section is again highly satisfactory. The number of plates etched by the photogravure process was 101, and the number of prints made from them amounted to 73,801. The outturn of photogravure prints for the past five years is shown below:—

1893-94	50,678	prints.
1894-95	49,675	"
1895-96	56,388	"
1896-97	72,246	"
1897-98	73,801	"

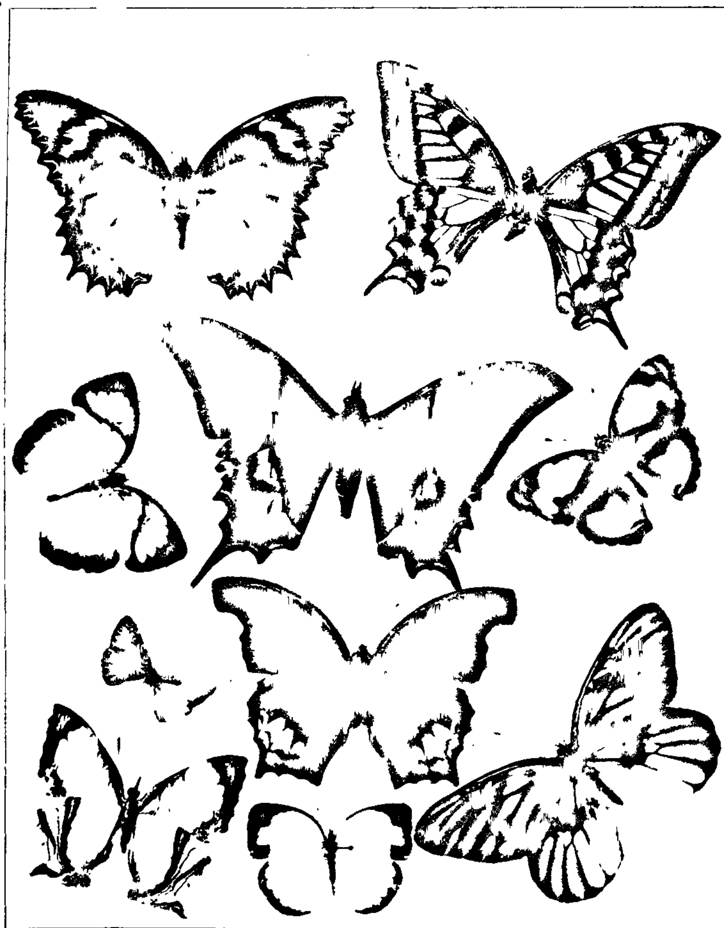
As this work continues to increase year by year it has been found necessary to indent for an additional copper-plate steam-printing machine, for which no extra establishment will be required.

The Enameline process, described in last year's Report, has been steadily worked, and has proved very useful in relieving the strain on the copper-plate printing staff. No change was made in the method of working the process, but with the new appliances received from England we were enabled to make some improvements in trimming, squaring and mounting the blocks, which will place the section in a better position to turn out work of this class in the future. The process has as yet hardly emerged from the experimental stage, and is handicapped by the pressure of other work, which prevents Mr. Turner from giving it all the attention he would wish. Eighty-two blocks were made by this process, yielding 8,100 prints. A specimen of the work done by this process will be found at page ~~xxxii.~~ 77.

The number of hand-engraved plates electrotyped was thirteen—the same number as last year.

At the request of the Surveyor-General some further experiments were made with an old, but not altogether satisfactory, method of preparing the hand-engraved plates to receive corrections by the electro-deposition of copper over the parts to be corrected. From experience gained in previous trials the method of working was slightly modified, and as the results were satisfactory, an outline of the process adopted is given here. The engraved plate is first thoroughly cleaned with caustic potash to remove all ink or greasy matter, washed in water, flooded with a weak solution of nitric acid, and again washed in water. It is now given a thin coat of silver by the application of a solution of cyanide of silver mixed to the consistency of cream with chalk. The plate is again washed, drained, and finally dried with a piece of fine muslin. The parts of the plate required to be removed or corrected are cut away with an engraving tool, leaving a depression in that

SPECIMEN OF TRICHROMATIC PHOTOGRAPHY.



PRINTED FROM THREE PHOTOGRAVURE PLATES,

Survey of India Offices, Calcutta. March 1899.

part and exposing a clean surface of copper. Close up to the portions of the surface thus removed a line about a sixteenth of an inch wide is made with black varnish, and when this is dry the plate is ready to be placed in the depositing battery, which gives an even deposit of copper all over the plate except in the parts where it is black varnished. In about three days sufficient copper is deposited to fill up the parts cut away, and the plate is then removed from the battery, washed and dried. The edges of the plate are then filed, and the layer of deposited copper is stripped off, separating easily from all parts of the plate in which the coating of silver remains, and adhering only to those parts in which the copper is exposed by cutting away to make the necessary alterations, and which have been separated from the remainder of the plate by the line of black varnish. The parts requiring correction have then to be scraped down to the level of the original plate when they are ready for the engraver to work upon. The advantage of this method is that it obviates the necessity of beating up the parts to be corrected from the back of the plate, which, if frequently repeated, causes buckling and eventually renders the plate unprintable.

Trichromatic Photography.—Mr. Turner has given some attention to this subject during the year, and has made a number of experiments in printing in natural colours by photo-mechanical means, the details of which may be given here.

The first stage in the process is to obtain three negatives, the varying gradations of which will represent the different shades of blue, red and yellow in the subject to be reproduced, which when combined will give an image more or less true to the original according to the coloured screens used in making the negatives and the inks used in printing the combined impressions. For this purpose Carbutt's orthochromatic colour screens were used, modified by fine films of gelatine or collodion, stained with such dyes as were found necessary to give the screens the correct tint. The only means of illumination available was sunlight reflected on to the subject by a large mirror. By this means a fully exposed negative was obtained for printing in blue, taken through a deep orange-coloured screen, in seven minutes. The negative for printing in red was taken through a green screen, and for the same subject required an exposure of three minutes. For the negative to be reproduced in yellow a violet screen was used, with an exposure of one second. It will thus be seen that the exposure through the orange screen was 420 times longer than through the violet screen, and 180 times longer than through the green one. The subject photographed was a set of brightly coloured butterflies, pinned to a white sheet of paper, and taken in the office studio with a 14-inch Ross-Goerz anastigmatic lens, with the full aperture.

Having obtained satisfactory negatives, the three images can be transferred to copper or zinc by any of the known photo-mechanical processes, and can then be printed, one colour superimposed upon the other, in blue, red and yellow inks, the correct colour values being dependent upon the colour of the inks employed. The annexed illustration is the result of these experiments with the sheet of butterflies referred to above. With the improvements constantly being made in the manufacture of sensitive plates, and increasing facilities for photo-mechanical reproduction, the process of photographic work in colour has a great future before it, and must eventually supersede chromo-lithography and monochrome reproduction for illustrating subjects in which the correct representation of colour is an important factor.

The above experiments have for the most part been carried on during the Pujahs and other holidays, as Mr. Turner's time is fully occupied during office hours with the current work of his section, and he has but little leisure for experimental work. He has as usual conducted the duties of his section with much skill and shown a keen interest in its improvement and development.

MACHINERY.—The new double-demy Express litho. and zinc-printing machine, made for the office by Messrs. Furnival & Co., of Reddich, was received in June 1898, and has proved to be a most useful addition to the resources of the office. As it registers with more accuracy than any of the older machines it will be especially useful for colour work. Sergeant Vandyke undertook to set it up, doing the work out of office hours and supplying his own labour, at a cost of R300. The last machine of a similar kind, received in the Office in 1893, was erected by the Public Works Department at a cost of R1,270 and after very considerable delay; and credit is due to Sergeant Vandyke for the speedy and thoroughly satisfactory manner in which he set up the new machine and got it in good running order unassisted. The machine first began to work on the 4th August, and up to the end of the year under report (a period of less than two months) had turned out 23,096 pulls and 30,780 copies.

The new beds, the necessity for which was explained on page XXXI of the Appendix to last year's Report, were also received, but have not as yet been used, as they were found to require certain alterations to make them fit our machines. These are being executed at the Cossipore Foundry.

The new spare pistons for the Willans' engine have also been received, and will be available in case of accident to the old ones, which would cause serious delay if they could not be at once replaced.

One of the type-printing machines and several of the old litho. and type presses, some of which have been running for over thirty years, are completely worn out and require replacing by new plant of modern construction. I have, therefore, included in the

annual store indent of this office for 1899-1900 the following new machines and presses, to be supplied by Messrs. R. Hoe & Co., all of which are urgently required :—

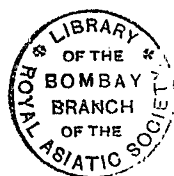
(1) An improved stop-cylinder type machine.
(2) A Washington hand type press.
(3) A litho. press to take a stone 60″ x 40″, arranged for either steam or hand power.
(4) A litho. press to take a stone 32″ x 24″, to be driven by hand power.

Some delay was caused in the early part of the year by the boiler having to be laid off for a few days for repairs, owing to one of the tubes suddenly beginning to leak and having to be taken out and replaced by a new one. The advisability of our having a second boiler to fall back upon in case of accident has been referred to in previous annual reports, and though the boiler inspector, who was specially asked to report upon the condition of the boiler at his last inspection, states that it is in fair working order and should last several years with care, it is felt that the risk of delay to the work, owing to such accidents as occurred during the year under report, is so serious that no more time should be lost in obtaining a second boiler. I have, therefore, indented for another 12-horse power multitubular boiler, by Messrs. Marshall, Sons & Co., makers of the old one, to be sent out complete, with injector and all the usual fittings. When received, it is intended to work both boilers alternately for a week at a time, which will enable us to keep both clean and in good working order, and should prolong the life of the present boiler by many years.

THE TOTAL SOLAR ECLIPSE.—The small party formed in this office to take photographs of the corona of January 22nd, 1898, consisting of myself, with Mr. H. Haward, Head Assistant, Mr. T. R. Theakston, Assistant Mathematical Instrument maker, and two native workmen, proceeded to Dumráon, in Bihar, on the 12th January and returned to Calcutta immediately after the eclipse. The photographs obtained were entirely successful. A report on the operations has already been submitted to the Government, and there is no need to give any further account of them here. A copy of the report was also sent to Captain E. H. Hills, R.E., Secretary to the Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society, at whose instance the observations were made, and in acknowledging it Captain Hills wrote as follows, dated 12th May 1898 :— "You seem to have got excellent results, and luckily yours was not a unique experience. We should much like to have a set of glass positives of your negatives, copied by contact. Could you manage to get these done and send them to the Royal Astronomical Society ? A glass positive shows up the delicate details so much better than any sort of print ; in fact a corona photograph should really never be looked at in any other way. I hope you will send your instrument to Sumatra in 1901." A set of glass positives made from the seven corona negatives taken by the party was accordingly prepared and sent.

INSTRUCTION TO OFFICERS FROM ROORKEE COLLEGE.—In the month of November 1897, the late Captain E. D. Bullen, R.E., Officiating Principal of the Roorkee Civil Engineering College, accompanied by Mr. J. O'Neill, Instructor in Drawing, visited Calcutta for the purpose of receiving instruction in photo-mechanical work and steam printing. Captain Bullen visited the office daily for about ten days and took notes of the various processes in which he was interested, with the view of introducing them into the regular curriculum at Roorkee. Mr. O'Neill remained here for a month, working principally at heliogravure and half-tone processes and lithographic printing. Two native printers also accompanied the party and remained in the office for three months, one being attached to one of the large litho. printing machines and the other to the Bremner type-printing machine. Both these men had had a certain amount of previous experience and profited fully by the instruction imparted to them here.

REORGANISATION OF THE OFFICE.—No orders were received during the year on the scheme for the re-grading of the office establishment and the amalgamation of it with the photo-zinco. and type-printing staff of the Trigonometrical Branch Office at Dehra Dún, which has been submitted to the Government for approval. As promotion among the European and Eurasian assistants is practically in abeyance, and there are several vacancies among them which it is undesirable to fill up until the scheme is sanctioned, it is greatly to be hoped that orders on the subject will not be delayed much longer.



PHOTOGRAPHIC AND

Abstract of Departmental Works

Specification.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic and Lithographic Printing.					Number of copies.		
			Photo-transfer prints.	Zinc-plates transferred.	Zinc plates printed.	Stones.	Pulls.	Coloured.	Uncoloured.	Total.
Departmental Maps, Plans, etc.										
General Maps	1	1	1	1	...	...	...	...	...	...
Provincial Maps	4	6	6	3	8	2	1,853	...	1,854	1,854
District Maps	44	108	110	34	27	10	3,344	...	3,346	3,346
Plans of Cities and cantonments	44	58	50	17	17	...	2,630	...	2,630	2,630
Standard Maps	221	322	380	134	82	...	12,435	...	12,235	12,235
Index Maps	32	23	27	49	94	11	37,600	20,536	4,648	25,184
Atlas Sheets	3	...	...	...	...	3	277	...	277	277
Technical Charts	20	21	18	6	5	...	125	...	150	150
Miscellaneous Maps, etc.	411	542	560	178	106	19	76,664	2,850	91,582	94,432
Transfers and Proofs	...	...	...	...	...	...	1,303	...	1,526	1,526
Departmental Forms	5	...	...	...	...	5	25,022	...	14,521	14,521
Type Printings	...	...	...	...	...	...	...	...	...	...
Totals (Normal)	785	1,081	1,152	422	339	50	161,253	23,386	132,769	156,155
Cadastral Maps.										
Assam—										
Photo-zincographs	144	144	176	155	155	...	9,085	...	9,085	9,085
Zincographs	99	...	...	99	99	...	5,577	...	5,577	5,577
Totals	243	144	176	254	254	...	14,662	...	14,662	14,662
Burma—										
Photo-zincographs	694	694	735	894	894	...	26,960	...	26,960	26,960
Zincographs	411	...	...	411	411	...	12,536	...	12,536	12,536
Totals	1,105	694	735	1,305	1,305	...	39,496	...	39,496	39,496
North-Western Provinces—										
Photo-zincographs	2,450	2,450	2,532	2,411	2,411	...	31,343	...	31,343	31,343
Zincographs	679	...	...	679	679	...	8,827	...	8,827	8,827
Totals	3,129	2,450	2,532	3,090	3,090	...	40,170	...	40,170	40,170
Transfers and Proofs	...	...	...	...	...	...	9,202	...	...	...
Totals (Cadastral)	4,477	3,288	3,443	4,649	4,649	...	103,530	...	94,328	94,328

LITHOGRAPHIC OFFICE.

done during the year 1897-98.

Type printing.			Silver and other Printing.		Heliogravure and Electrotyping.				Value.
Pages or items.	Pulls.	Copies.	Silver prints.	Blue prints.	Heliogravure plates.	Heliogravure Prints.	Photo-blocks.	Electrotypes.	R a. p.
...	...	...	...	...	...	...	...	...	13 4 0
...	...	...	...	...	...	...	...	...	973 3 9
...	...	...	...	...	...	...	...	...	3,475 1 0
...	...	...	...	48	...	...	...	...	1,760 1 6
...	...	...	...	744	...	...	...	...	10,573 6 3
...	...	...	...	64	...	...	...	...	2,506 9 6
...	...	...	...	...	...	...	...	...	211 6 3
...	...	...	...	75	...	...	...	...	321 15 6
...	...	...	230	475	8	2,521	7	13	22,885 1 3
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	877 10 0
13,819	1,176,837	700,756	...	...	...	...	...	...	15,216 5 3
13,819	1,176,837	700,756	230	1,306	8	2,521	7	13	58,654 0 3
...	...	...	...	...	...	...	...	...	3,240 5 0
...	...	...	...	...	...	...	...	...	4,326 8 6
...	...	...	...	...	...	...	...	...	4,566 13 6
...	...	...	...	...	...	...	...	...	12,478 3 3
...	...	...	...	...	...	...	...	...	3,426 0 0
...	...	...	...	...	...	...	...	...	15,904 3 3
...	...	...	...	...	...	...	...	...	31,892 6 3
...	...	...	...	...	...	...	...	...	3,972 7 3
...	...	...	...	...	...	...	...	...	35,864 13 6
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	56,335 14 3

PHOTOGRAPHIC AND

Statement of Work done for other

Departments, etc.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic and				
			Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Stones.	Pulls.
Adjutant General in India	1	...	...	...	...	1	94
Administrative Medical Officer, Central Provinces	1	1	1	1	1	...	255
Agent and Chief Engineer, Bengal and North-Western Railway	3	4	4	3	3	...	350
Agent and Chief Engineer, Assam-Bengal Railway Company, Limited	9	9	9	3	...	...	...
Agent to the Governor-General, Central India and Rájputána	1	...	...	...	...	3	195
Architectural Surveyor, North-Western Provinces and Oudh	23	23	59	17	17	...	11,050
Asiatic Society of Bengal	19	21	2	2	2	1	1,972
Board of Revenue, Bengal	5	...	...	...	3	4	1,020
Calcutta Municipality	1	...	...	2	...	1	150
Chamber of Commerce, Calcutta	...	...	...	...	...	...	...
Chief Commissioner, Assam	1	...	...	...	3	2	7,500
" " Central Provinces	3	...	...	4	10	11	9,580
" Engineer, Bengal Public Works Department	6	15	15	8	8	4	3,700
" " Public Works Department, Punjab	6	13	13	4	4	...	1,100
" " Irrigation Works, Punjab	25	19	19	20	19	3	12,260
" " East Indian Railway	41	43	43	13	15	1	1,707
Collector of Customs, Calcutta	7	...	...	...	...	10	5,500
Colonial Secretary, Singapur	1	4	4	2	2	...	1,000
Commissioner of Excise, Bengal	6	...	...	...	2	6	3,480
" of " Punjab	7	...	...	...	...	8	1,720
" of Police, Calcutta	1	...	...	...	...	2	2,168
" of Gurgaon	1	...	...	...	...	1	105
" of Patna Division	10	...	...	2	2	20	12,150
Commissary General-in-Chief	1	...	...	...	...	1	12
Conservator of Forests, Bengal	2	...	...	...	...	3	70
" " Tenasserim Circle	20	9	6	2	1	2	110
Dacca Municipality	1	...	...	...	...	1	100
Deputy Adjutant General, Bengal	5	11	11	5	7	...	750
" Assistant Adjutant General, Oudh District	5	6	...	...	...	...	...
" Commissioner, Lahore	1	...	...	...	...	1	105
" Conservator of Forests (through Printing, India)	1	1	1	1	1	...	1,008
" " " Coorg	1	1	1	1	1	...	40
" " of Port, Rangoon	1	...	...	...	...	1	100
" Consulting Engineer to the Government of India for State Railways	...	...	...	...	4	...	212
Deputy Post Master General, Burma	1	...	...	...	...	4	600
Divisional Engineer, Gwalior Light Railways	3	...	...	...	4	5	1,200
Director, Botanical Survey of India	4	1	...	2	2	2	1,560
" Geological Survey of India	55	23	...	...	...	4	1,560
" Royal Indian Marine	12	24	...	...	...	...	...
" " Survey, Bangkôk	23	95	95	41	45	...	2,890
" General of Military Works	19	43	43	15	15	21	6,577
" " of Post Office, India	7	8	...	...	...	8	1,760
" " of Telegraphs	14	1	1	1	1	12	5,640
" of Land Records and Agriculture, Assam	5	5	...	...	...	...	...
" " " " " Bengal	30	3	3	1	23	21	19,820
" " " " " Burma	9	20	20	9	20	...	722
" " " Punjab	7	25	25	7	8	...	1,560
" " " Gwalior State	3	...	...	...	1	1	5,000
" of Military Education in India	1	...	...	...	...	3	900
" of Public Instruction, Bengal	7	...	...	...	...	7	3,927
" of Railway Construction	10	7	7	4	8	...	1,800
Engineer-in-Chief, Bombay, Sind Connection Railway	1	...	...	...	...	3	225
" " Eastern Bengal State Railway	24	27	27	8	8	2	525
" " N. W. Railway	1	1	1	...	...	...	...
" " Goona Bara Railway	1	...	...	...	1	1	240
" " Vizianagram	1	2	2	1	...	...	...
Famine Administration, Central Provinces	...	...	...	2	2	...	1,200
Financial Commissioner, Punjab	2	...	...	...	2	5	1,610
General Officer Commanding Meerut District	...	...	...	...	1	...	50
" " " Presidency District	1	4	4	1	1	...	120
" " " Punjab Frontier Force	2	6	6	2	3	...	470
" " " Sirhind District	...	...	...	...	1	...	75
" " " Tirah Expeditionary Force	13	4	4	2	2	9	2,100
Government of India, Revenue and Agricultural Department	20	31	3	...	10	8	18,150
Carried over	492	510	429	186	263	203	159,844

LITHOGRAPHIC OFFICE.

Departments during the year 1897-98.

Lithographic printing.			Silver and other Printing.		Heliogravure and Electrotyping.				Value.		
Number of copies.											
Coloured.	Uncoloured.	Total.	Silver prints.	Blue prints.	Heliogravure plates.	Heliogravure prints.	Photo-blocks.	Electrotypes.	R	a.	p.
27	20	47	...	...	...	...	...	...	35	7	0
...	255	255	...	...		...	...	...	32	0	0
...	350	350	...	...	...	...	...	...	105	3	6
...	...	...	...	...	...	...	...	...	122	4	0
65	...	65	...	...	...	...	...	...	58	13	0
...	38,350	38,350	10	90	...	13,650	...	...	4,413	8	0
...	1,972	1,972	...	11	10	9,686	...	...	2,220	4	0
620	...	620	...	...	...	...	...	...	187	13	0
...	150	150	...	...	...	...	...	...	57	12	0
...	...	...	...	...	...	300	...	...	36	0	0
375	6,000	6,375	...	...	...	...	...	...	476	3	0
1,325	3,800	5,125	...	...	...	...	...	...	882	13	6
1,500	700	2,200	...	...	...	...	...	...	598	13	3
...	1,200	1,200	...	...	...	...	...	...	413	6	3
...	16,910	16,910	...	...	...	...	...	...	1,459	6	9
...	4,031	4,031	...	...	...	...	...	...	1,205	6	3
3,850	...	3,850	...	...	...	...	...	...	593	4	0
...	1,000	1,000	...	...	...	...	...	...	327	3	3
2,450	50	2,500	...	...	...	...	...	...	297	12	0
1,505	...	1,505	...	...	...	...	...	...	340	8	0
1,084	...	1,084	...	...	...	...	...	...	170	8	0
...	105	105	...	...	...	...	...	...	44	15	0
2,200	3,875	6,075	...	...	...	...	...	...	1,459	13	6
...	12	12	...	...	...	...	...	...	30	0	0
20	30	50	...	...	...	...	...	...	147	12	0
40	30	70	...	...	...	...	...	...	274	3	0
...	100	100	...	...	...	...	...	...	21	7	0
...	550	550	...	...	...	...	...	...	247	0	3
...	...	...	...	12	...	...	...	...	56	0	0
...	105	105	...	...	...	...	...	...	14	14	0
...	1,008	1,008	...	...	...	...	...	...	80	1	0
...	40	40	...	...	...	...	...	...	16	9	0
...	100	100	...	...	...	...	...	...	250	0	0
...	156	156	...	...	...	...	...	...	76	15	0
...	150	150	...	...	...	...	...	...	699	1	0
400	...	400	...	...	...	...	...	...	202	7	0
880	340	1,220	...	2	...	...	...	...	149	10	9
...	1,560	1,560	4	7	23	17,023	28	...	3,702	12	0
...	...	...	...	...	12	2,762	...	...	1,126	0	0
...	2,890	2,890	...	...	...	...	...	...	2,497	9	9
950	1,377	2,327	...	...	...	...	...	...	1,670	12	0
90	1,230	1,320	...	...	4	2,204	...	...	317	2	0
...	6,090	6,090	...	...	...	...	...	...	698	10	9
...	...	...	...	...	...	...	5	...	126	0	0
8,645	4,805	13,450	...	...	...	...	...	...	1,989	7	0
...	722	722	...	...	...	...	...	...	826	2	6
...	1,560	1,560	...	...	...	...	...	...	745	1	9
...	5,000	5,000	...	...	...	...	...	...	523	11	0
300	...	300	...	...	...	...	...	...	182	3	0
3,235	60	3,295	...	...	...	...	...	...	314	4	0
...	4,500	4,500	...	...	...	...	...	...	221	7	9
75	...	75	...	...	...	...	...	...	41	5	0
100	712	812	...	...	...	...	...	...	472	14	6
...	...	...	...	...	...	...	...	...	9	12	0
120	...	120	...	...	...	...	...	...	41	15	0
...	...	...	...	...	...	...	...	...	31	8	0
...	1,200	1,200	...	...	...	...	...	...	84	5	3
460	...	460	...	...	...	...	...	...	289	8	0
...	50	50	...	...	...	...	...	...	12	5	3
...	120	120	...	...	...	...	...	...	89	13	0
...	470	470	...	...	...	...	...	...	209	4	0
...	75	75	...	...	...	...	...	...	20	11	9
...	2,950	2,950	...	...	...	...	...	...	498	1	6
4,150	1,200	5,350	...	28	13	9,013	...	...	3,217	7	6
34,466	117,960	152,426	14	150	62	54,638	33	...	37,765	3	6

PHOTOGRAPHIC AND

Statement of Work done for other

Departments, etc.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic and				
			Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Stones.	Pulls.
Brought forward	492	510	429	186	263	203	159,844
Government of India, Finance and Commerce Department	1	...	...	...	...	1	450
Government of India Foreign Department	15	3	3	...	...	19	1,272
" " Home Department	30	16	16	61	66	20	84,080
" " Military Department	9	4	4	2	4	8	1,620
" " Public Works Department	34	10	12	6	34	17	34,851
" Bengal, Revenue and General Department	7	...	...	...	2	11	31,786
Government of Bengal, Judicial and Political Department	1	...	...	...	...	1	50
Government of Bengal, Financial Department	...	...	...	...	...	...	686
" " Marine Department	45	...	...	...	45	24	15,450
" " Public Works Department, Irrigation Branch	16	8	12	7	12	7	6,320
Government of Bengal, Municipal Department	2	...	...	...	...	2	200
" Bombay, Public Works Department, Railway Branch	...	..	...	...	2	...	40
Government of North-Western Provinces and Oudh, Public Works Department	3	...	...	...	16	3	8,100
Government of Punjab, Public Works Department	2	1	1	1	1	1	106
Government Epigraphist, Madras	5	4	...	...	...	...	...
Indian Museum	20	40	...	...	...	...	...
Inspecting Officer, Rájputána Imperial Service Infantry	4	12	12	4	4	...	150
Inspector General of Artillery in India	8	...	...	...	3	6	5,834
" " Civil Veterinary Department	6	...	...	...	...	7	1,040
" " Jails, Bengal	1	...	...	...	...	1	50
" " Police, Bengal	80	17	...	...	...	11	6,050
" " Civil Hospitals, Bengal	...	...	...	...	2	...	1,500
Magistrate of the 24-Parganas	3	3	...	...	...	...	...
Manager, North-Western Railway	1	...	...	...	...	1	7,000
Master of the Mint, Calcutta	3	3	...	...	...	1	100
Meteorological Reporter to the Government of Bengal	9	...	...	...	9	2	66,209
" " to the Government of India	21	...	...	..	9	12	65,765
Military Authorities, Quetta	1	4	4	...	...	...	...
Officer Commanding the Hyderabad Contingent	...	...	...	...	1	...	100
" " Oudh District	2	8	8	2	2	...	140
" in charge, Andamanese	1	4	4	...	...	1	1,150
Photographic Society, India	5	6	...	...	...	...	...
Port Commissioners, Calcutta	3	14	8	3	4	...	480
Port Officer and Registrar of Wrecks, Calcutta	2	...	...	...	...	4	528
Principal, Civil Engineering College, Sibpur	...	...	...	...	...	...	.
Quarter Master General in India	4	1	1	1	11	5	12,251
Rangoon Municipality	77	151	12	5	3	...	500
Reporter of Economic Products to the Government of India	4	...	...	...	7	1	3,750
Resident Engineer, Benares Water Works, Sewerage	1	1	1	2	1	...	100
Resident, Western Rájputána States	...	...	...	22	30	...	7,800
Sanitary Commissioner, Assam	1	...	...	...	...	1	300
" " Bengal	13	6	6	2	2	12	6,680
" " Central Provinces	...	...	...	1	2	...	460
" " Hyderabad Assigned Districts	1	...	...	...	...	2	400
" " with the Government of India	1	...	...	...	...	4	3,812
Secretary for Berar to the Resident at Hyderabad	...	...	...	...	1	...	325
Secretary, Lady Dufferin's Fund	1	...	...	...	...	2	3,000
Station Staff Officer, Siálkot	...	...	...	...	1	...	100
Superintending Engineer, Hyderabad, Public Works Department	1	...	...	...	...	1	20
Superintending Engineer, Irrigation Circle, Upper Burma	3	...	...	...	1	1	750
Superintendent, Archæological Survey, Madras	...	...	...	...	16	...	4,800
" Civil Veterinary Department, Bengal	2	...	...	...	...	3	2,700
" Forest Surveys, Dehra Dún	6	5	...	...	...	1	36
" Government School of Arts	...	...	...	...	...	...	...
" " Printing, India	102	23	20	4	14	55	17,380
" " Press, North-Western Provinces and Oudh	33	5	1	...	...	10	3,675
Superintendent of Stationery, Calcutta	2	...	...	...	3	2	6,177
" of Survey and Settlement, Darbhanga	1	...	...	...	...	1	500
Special work done for trade and Private Individuals	17	14	13	7	7	10	2,667
Pulls and Proofs	...	...	...	...	...	...	1,645
Total	1,102	873	566	316	578	474	5,80,779

LITHOGRAPHIC OFFICE.

Departments during the year 1897-98—contd.

Lithographic Printing.			Silver and other printing.		Heliogravure and Electrotyping.				Value.		
Number of copies.											
Coloured.	Uncoloured.	Total.	Silver prints.	Blue prints.	Heliogravure plates.	Heliogravure prints.	Photo.-blocks.	Electrotypes.	R	a.	p.
34,466	117,960	152,426	14	150	62	54,638	33	...	37,765	3	6
...	450	450	...	...	...	...	...	...	69	12	0
216	430	646	...	...	...	600	...	...	971	15	0
5,010	23,070	28,080	...	...	...	...	...	...	6,542	3	3
380	800	1,180	...	...	...	...	...	...	370	11	0
4,502	11,061	15,563	...	...	...	...	...	...	3,579	1	0
19,577	1,350	20,927	...	...	...	...	...	...	1,629	12	6
...	50	50	...	...	...	...	...	...	34	12	0
686	...	686	...	...	...	...	...	...	27	5	0
10,440	...	10,440	...	...	...	...	...	...	1,759	12	0
1,080	1,520	2,600	...	3	...	...	...	...	1,029	7	3
...	200	200	...	...	...	...	...	...	86	3	0
...	40	40	...	...	...	...	...	...	18	4	0
2,100	...	2,100	...	...	...	...	...	...	569	8	0
...	106	106	...	...	...	...	...	...	32	8	3
...	...	...	...	...	4	2,804	...	...	585	0	0
...	...	...	...	28	20	6,020	...	...	1,888	8	0
...	150	150	...	...	...	...	...	...	201	6	6
120	6,754	6,874	...	...	...	...	...	...	700	11	0
300	640	940	...	...	...	...	...	...	485	1	0
...	50	50	...	...	...	...	...	...	79	7	0
3,300	...	3,300	...	...	...	...	37	...	746	1	0
...	1,500	1,500	...	...	...	...	...	...	90	13	0
...	...	...	...	6	...	...	...	...	30	0	0
...	7,000	7,000	...	...	...	...	...	...	410	5	0
...	100	100	...	...	...	...	...	...	34	4	0
146	44,830	44,976	...	...	...	...	...	...	763	15	0
8,040	61,130	69,170	...	...	...	...	...	...	1,637	3	6
...	...	...	...	8	...	...	...	...	52	8	0
...	100	100	...	...	...	...	...	...	21	9	0
...	140	140	...	...	...	...	...	...	138	7	6
...	230	230	...	...	...	...	...	...	500	8	0
...	...	...	...	...	6	6,607	...	...	350	0	0
...	480	480	...	...	...	...	...	...	320	11	0
132	132	264	...	...	...	...	...	...	111	6	0
...	...	...	...	...	...	75	...	...	12	0	0
1,470	641	2,111	...	...	...	...	...	...	1,078	6	3
...	500	500	...	662	...	...	...	...	2,630	13	0
200	2,350	2,550	...	...	...	...	...	...	200	0	0
...	200	200	...	...	...	...	...	...	48	7	3
...	2,080	2,080	...	...	...	...	...	...	1,405	0	0
...	300	300	...	...	...	...	...	...	16	8	0
3,550	1,810	5,360	...	...	...	...	...	...	959	13	6
...	230	230	...	...	...	...	...	...	25	3	0
200	...	200	...	...	...	...	...	...	29	3	0
950	12	962	...	...	...	...	...	...	498	0	0
...	325	325	...	...	...	...	...	...	10	2	6
1,500	...	1,500	...	...	...	...	...	...	160	9	0
...	100	100	...	...	...	...	...	...	24	10	6
...	20	20	...	...	...	...	...	...	373	1	0
...	1,000	1,000	...	...	...	...	...	...	64	0	0
...	18,600	18,600	...	...	...	300	...	...	928	12	0
800	800	1,600	...	...	...	...	...	...	150	5	0
...	36	36	...	...	...	...	...	...	86	3	0
...	...	...	12	...	...	...	...	...	24	0	0
1,510	15,951	17,461	...	11	...	235	...	...	3,418	11	3
780	7,735	8,515	...	...	...	...	5	...	1,010	12	0
...	6,177	6,177	...	...	...	...	...	...	339	8	0
...	500	500	...	...	...	...	...	...	131	3	0
...	2,667	2,667	27	...	1	1	...	...	678	4	0
...	1,567	1,567	...	...	...	...	...	...	...		
101,455	343,874	445,329	53	868	93	71,280	75	...	77,937	9	6

MATHEMATICAL INSTRUMENT OFFICE.

TABLE A.

Details of Issues and Receipts from Provinces and Departments during the Financial year 1897-98.

PROVINCES AND DEPARTMENTS.	VALUE OF			
	Receipts.	Issues.	Debits.	Credits.
	R	R	R	R
Assam	...	8,780	8,780	...
Bengal, Civil	24,652	35,658	11,006	...
„ Military, Bengal Command	305	9,792	9,487	...
„ „ Punjab „	4,927	31,128	26,201	...
Bombay, Civil	278	4,208	3,930	...
„ Military	...	10,128	10,128	...
Burma	2,934	15,489	12,555	...
Central India	...	62	62	...
„ Provinces	180	7,220	7,040	...
Foreign States, Berar	92	381	289	...
Forests	...	7,782	7,782	...
Geological Survey and Museums	...	256	256	...
Guaranteed Railways, East Indian Railway	...	3,564	3,564	...
Madras, Civil	6,142	11,450	5,308	...
„ Military	562	2,335	1,773	...
Marine	65	846	781	...
Meteorological Department	...	1,930	1,930	...
Mint	157	...	...	157
North-Western Provinces and Oudh	5,071	6,146	1,075	...
„ State Railway, Public Works Department	15,890	2,183	...	13,707
Public Works Department, Military Works	525	2,259	1,734	...
Public Works Department, Balúchistán, Railway Branch	1,985	...	...	1,985
Public Works Department, Balúchistán, Ordinary Branch	...	66	66	...
Punjab	2,465	11,030	8,565	...
Rájputána, Public Works Department, and Central India	86	1,144	1,058	...
Survey Department, Field Parties	30,168	71,764	41,596	...
„ „ Head Quarter's Offices, Calcutta and Dehra Dún	4,302	11,638	7,336	...
TOTAL	1,00,786	2,57,239	1,72,302	15,849
NET DEBIT	...	...	1,56,453	...
CASH SALES	...	...	38,776	...
GRAND TOTAL	...	...	1,95,229	...

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the local market during 1897-98.

Specification.	Number.	Value. R	a.
Instruments.			
Barometers, aneroid, ordinary	3	240	0
Boards, drawing or sketching, cavalry pattern	24	804	0
Callipers, micrometer, small	2	55	0
Cameras, lucida, for sketching	1	634	0
Cards for prismatic compasses	125	275	0
Cases, leather and morocco, spare	152	399	8
Chronographs, watch pattern	14	350	0
Clinometers, Watkins' pattern	16	512	8
" survey pattern	24	348	0
Clocks	14	345	0
Compasses, bow, ink, brass, double jointed	12	90	0
" " " electrum " "	12	102	0
" " " " spring	24	156	0
" magnetic, pocket, in electrum cases	12	144	0
" " rectangular, 2" × 2½"	73	511	0
" " " 3" × 3½"	12	96	0
" " " 5"	199	2,587	0
" " " 6"	118	1,770	0
" proportional, electrum, 6"	12	228	0
Canvas covers, for planetables	86	476	12
Ghat tracers	2	100	10
Glasses, binocular, large	15	570	0
Havresacks	62	93	12
Instruments, drawing, electrum, 2nd sort	12	600	0
Lamps, argand	6	19	8
Levels, spirit, in wooden case, 6"	4	8	0
" " " " " 8"	4	9	2
Map printing machines, Ordnance	18	855	0
Mekometers	1	245	0
Pedometers	15	444	0
Pens, double, or road	24	144	0
Protractors, cardboard, circular, 9"	6	30	0
" rectangular, ivory, 6"	36	210	0
" " wooden, 6"	60	117	0
Rules, parallel, bar, wooden, 6"	204	153	0
" " on rollers, brass, 12"	3	90	0
" " " " 18"	3	144	0
" " " wooden	34	491	0
" sight, wooden	400	1,200	0
Scales, diagonal, wooden	773	478	5
" marquois, wooden, sets	1	5	0
" offsets, single, wooden	30	11	4
" plotting, sets, wooden	12	276	0
" " single "	300	656	4
Squares, set, ebonite	20	174	0
" " " single	154	303	0
" optical	572	3,718	0
Stands for planetables, survey pattern	220	1,540	0
Staves, levelling, telescopic, Sopwith's	175	2,625	0
Stencil plates	13	20	0
Sundials	2	300	0
Tapes, measuring, metallic, 50'	29	126	14
" " " 66'	52	322	0
" metallic, of sizes	6	16	8
" steel, 100'	11	314	8
Carried over	4,214	26,534	7

MATHEMATICAL INSTRUMENT OFFICE.

TABLE B.

Instruments, etc., purchased in the local market during 1897-98—concluded.

SPECIFICATION.	Number.	Value.	
Instruments—concluded.		R	a.
Brought forward	4,214	26,534	7
Telescopes of sorts	12	144	0
Thermometers, common, in tin case	19	32	12
" maximum, self-registering	6	156	0
Trunks, mule	42	651	12
Umbrellas, surveying	42	631	0
Watches, common	88	2,304	0
" stop	6	1,050	0
TOTAL	4,429	31,503	15
Books.			
Hints to travellers	6	38	9
Chamber's hand book of astronomy	2	32	0
Manual of surveying (Thuillier's)	1	12	0
Nautical almanacs	68	172	9
Tables, log, Hutton's	3	20	10
" " Shortrede's, sines, etc.	4	93	12
" traverse, Boileau's	4	36	8
TOTAL	88	406	0
Sundries.			
Brushes, stencil	84	41	4
Glasses, ink, bottles	96	36	0
Apparatus, camera	1	175	0
Boxes, brass, for rectangular compasses, 5"	50	575	0
" " " " 6"	50	625	0
Carbon paper, black	Doz. 2	6	12
Chimneys, for lamps	48	12	8
Cold chisels	12	18	0
Cords for mekometers	500	100	0
Dogs, Yost Type-writer	1	10	8
Eyelets, brass	60	22	8
Frames and fittings, brass, for clinometers, survey pattern	112	2,011	0
Frena cameras	1	65	0
Hammers	4	5	12
Impression strips	3	0	12
Jewel lamps	2	7	8
Lactometers	34	84	14
Leather stamps, etc.	21	4	0
Papers, Legal, No. 1	Doz. ½	4	12
Pump spring bow ink	28	301	0
Springs, punch, plier	2	7	0
Stencil inks, black	18	9	0
" " red	4	3	0
" " blue	6	4	8
Steel yards	3	108	0
Wicks for lamps	96	9	13
Types	sets 2	614	11
TOTAL	1,240½	4,863	2
TOTAL OF BOOKS	88	406	0
" " INSTRUMENTS	4,429	31,503	15
SUM TOTAL	5,757½	36,773	1

MATHEMATICAL INSTRUMENT OFFICE.

Table C.

Instruments, etc., manufactured in the Mathematical Instrument Office during 1897-98.

Specification.	Number.	Value.	
Instruments.		R	a.
Boards, drawing, deal	86	1,080	0
Chains, measuring, iron, 66′	310	1,085	0
" " " 100′	160	1,120	0
" steel,	140	1,270	0
" of sorts and sizes	44	201	0
Clinometers, survey pattern	104	3,228	0
" wooden, with shade scale	12	18	0
Combs, acre, card-board	4,000	1,500	0
Compasses, magnetic, rectangular, 5″	19	247	0
" " " 6″	24	360	0
Canvas covers, for plane-tables	2	10	12
Curves, French, wooden, sets	1	1	8
Gauges, writing	60	132	0
Glasses, copying or tracing	3	115	0
Hold-alls, leather	172	3,044	0
Lamps, argand	7	880	0
Pins, for chains, ordinary	1,012	92	12
Plane-tables, survey pattern	100	643	0
" deal, military pattern	18	240	0
Plates, graticule	2	130	0
Pluviometers, Symon's	125	775	0
Protractors, horn	6	72	0
Rods, measuring	25	31	4
Rules, flat, ebonite, plain, 18″	4	12	0
" " wooden, " 12″	105	19	11
" " " " 2′	82	20	8
" sight, brass	18	288	0
" " wooden	50	300	0
Scales, card-board, miscellaneous	1,150	187	8
" diagonal, card-board	4,500	1,125	0
" engineering, metal	18	180	0
Sheets, celluloid	993	682	2
Stamps, for conventional signs	80	164	0
Stands, for heliotropes	22	348	0
" " levels, dumpy	6	21	0
" " telescopes, metal	1	40	0
" " theodolites, transit, 5″	8	355	0
" " " " 6″	6	260	0
" " " " railway, 5″ and 6″	25	1,060	0
Staves, cross or offsets	12	60	0
" levelling, Roorkee, double	12	291	0
" " sopwith's, telescopic	218	5,405	0
Stencil plates	365	784	0
Tapes, metallic, 66′	2	9	8
Thermometers, maximum and minimum, 9″ sets	5	100	0
Yards, standard	3	180	0
Total	14,117	28,168	9
Sundries.			
Boxes, of sorts	21	79	7
Alum-contact breakers	3	90	0
Back board, for pluviometer	4	60	0
Brass moulds	1	8	0
Bubble testers	1	16	0
Carried over	30	253	7

MATHEMATICAL INSTRUMENT OFFICE.

TABLE C.

Instruments, etc., manufactured in the Mathematical Instrument Office during 1897-98—concluded.

SPECIFICATION.	Number.	Value. R	a.
Sundries—concluded.			
Brought forward	30	253	7
Corner-pieces, brass	2	9	0
Cords and Reels, for Mekometers	1	22	8
Doolies	1	1	12
Ferrotype printing frames	2	110	0
Glass plates, square	2	12	0
Gauges, steel	18	36	0
Handles, brass, for chains	4	2	0
Screws, brass	19	17	12
Silvered glasses	1	2	0
Seismometers	1	60	0
Tops, brass, rain-gauge	12	54	0
Zinc tickets	152	4	12
" bottles, for pluviometers	12	12	0
TOTAL	257	597	3
SUM TOTAL	14,374	28,765	12

MATHEMATICAL INSTRUMENT OFFICE.

Table D.

List of principal instruments repaired in Workshop during the financial year 1897-98.

Specification.	Number.
Anemographs, of sorts	4
Anemometers, "	30
Arithmometers	1
Balances, chemical	1
Barographs	1
Barometers, of sorts	110
Bars, lengthening	1
Boards, drawing, of sorts	3
Cameras	3
Chains, of sorts	116
Chronographs, of sorts	18
Chronometers, "	6
Chrono-micrometers, of sorts	2
Clinometers, of sorts	157
Clocks	14
Compasses, beam, of sorts	4
" bow, ink and pencil, of sorts	115
" " dividers	27
" drawing, of sorts	184
" magnetic, "	90
" prismatic, "	151
" proportional "	13
" surveying, "	3
Cords and Reels	47
Curves	1
Ghat tracers	1
Glasses, binocular, of sorts	32
" magnifying	1
" measure	3
Heliographs	24
Heliotropes	25
Horizons, mercurial, ordinary	1
Hydro-clinometers	1
Hydrometers	28
Hygrometers	7
Hypsometers	1
Indicators	2
Instruments, drawing, mathematical, of sorts	127
Lamps, of sorts	2
Lens, reading	1
Levels, of sorts	178
" spirit	10
Magnets	2
Map printing machines	2
Mekometers	106
Micrometers	2
Microscopes	5
Mining dials	2
Pens, drawing, of sorts	239
" dotting	1
Pentagraphs	7
Perambulators	1
Pins, of sorts	97
Plane tables, of sorts	69
Planimeters	6
Pluviometers or rain-gauges	4
Pointers, station	5
Protractors, of sorts	24
Range-finders	10
Carried over	2,128

MATHEMATICAL INSTRUMENT OFFICE.

TABLE D.

List of principal instruments repaired in Workshop during the financial year 1897-98—concluded.

Specification.	Number.
Brought forward	2,128
Rules, of sorts	201
Scales, " "	45
Scott's sights, B. L., telescopic	98
Sectors	3
Set squares	1
Sextants, of sorts	26
Squares, optical	164
Stands, for camera	1
" " compasses	62
" " heliographs	7
" " levels	89
" " mining dial	1
" " plane-tables	50
" " sextants	1
" " theodolites	57
Staves, levelling, of sorts	122
Sundials	1
T squares	3
Tapes, of sorts	545
Telemeters, of sorts	21
Telescopes, " "	172
Theodolites, " "	123
Thermographs	1
Thermometers, of sorts	51
Time-pieces	1
Type writers, of sorts	17
Vanes, wind	2
Walker's harpoon log	1
Yards, steel	1
Watches, common	6
TOTAL OF PRINCIPAL INSTRUMENTS REPAIRED	4,001
" " MINOR INSTRUMENTS REPAIRED	1,105
TOTAL OF ALL INSTRUMENTS REPAIRED	5,106

MATHEMATICAL INSTRUMENT OFFICE.

Profit and Loss account of the Workshop for the financial year 1897-98.

Debits.	R	a.	Credits.	R	a.	R	a.
To Workshop establishment (less proportion debitable to the Store Branch for cleaning and adjusting serviceable instruments) . . .	43,528	1	By repairs for public officers on book debit	14,651	0		
,, One-third of office establishment	2,710	3	,, repairs for public officers on payment .	9,833	6	24,484	6
,, Pay of Material Store-keeper for the whole year .	780	0	,, repairs for stock . .			39,672	15
,, Workshop contingencies as distinguished from materials purchased . . .	3,104	8	,, manufacture for stock— instruments . .			27,556	12
,, Value of materials :— For ordinary work . . ,, general workshop use . ,, manufacture of packing cases . . .	29,047	11	packing cases . .			1,574	2
,, Paid for repairs . .	135	8	,, manufacture of material .			3,959	0
,, Wear and tear of plant .	811	1					
,, Half of rent at R600 per mensem	3,600	0					
,, Printing and stationery .	379	5					
,, Four per cent. on value of tools and plant amounting to R1,42,522-11 . .	5,700	15					
,, Half of rates, taxes, etc. .	877	0					
,, Liability for pensions .	3,948	0					
,, Profit	2,624	15					
TOTAL .	97,247	3	TOTAL .			97,247	3

TRIGONOMETRICAL BRANCH OFFICE, DEHRA DÚN.

Narrative Report of MR. J. ECCLES, M. A., *Superintendent, 2nd grade, in charge Computing Party, Season 1897-98.*

The occurrence of the total solar eclipse necessitated the absence of some officers for a short time. Mr. Eccles visited Dumráon to take part in the observations at that place. Mr. McA' Fee left Dehra on the 28th December and proceeded to Sahdol to help in the arrangements for the camp and to assist Major Burrard in the observations : he also made a plane-table survey of the camp, on the scale of 48 inches to the mile. He returned to Dehra on the 14th Feburary 1898. Four Computers, Babus Shoshi Bhoosan Shome, Shiv Nath Saha, Isan Chandra Dev and Sarat Chandra Guha, were sent to Pulgáon in the Central Provinces to help the party there. They were absent for 17 days.

Before proceeding to the field, Lieutenant H. H. Turner, R.E., Assistant Superintendent, 1st grade, of No. 24 Party, was instructed in the use of the 24-inch theodolite with which he took a set of azimuth observations.

Lieutenant E. A. Tandy, R.E., Assistant Superintendent, 2nd grade, on appointment to the Department, was posted to this Office on the 31st January, and was put through a course of astronomical observations, and triangulation, and taught the methods of computations used in the Department: he was also shown the working of the various sections of the Trigonometrical Branch office. He was transferred to No. 22 Party on the 25th August. Lieutenant A. Mears, I.S.C., Assistant Superintendent, 2nd grade, was transferred to this office from Nos. 9 and 19 Parties on the 13th April. He was put through a course of instruction in the methods of astronomical observations and the computations of the Trigonometrical Branch and in levelling. He passed the departmental examination and was confirmed on the 4th August. Both these officers were attached for a short time to the training school to learn plane-tabling. Mr. A. E. Wackrill, Superintendent of Trigonometrical Surveys, Ceylon, who came here to acquaint himself with the methods of observing and computing, as well as with all details in connection with field and office work obtaining in the Survey of India Department, left the Office about the middle of November.

For the first time in the history of this Office a training class for the newly appointed officers of the Provincial Service was started, and the six Probationary Sub-Assistant Superintendents on appointment to the Department were posted to the office for training, instead of directly to a field party. They were attached to the training school and received a regular course of professional instruction in the plane-table, theodolite and level, and were shown the processes in the various sections of the Trigonometrical Branch Office. They were also instructed in topographical drawing and in the computations of the Topographical Branch.

In the training school, in addition to the above, a class of 17 apprentice sub-surveyors was instructed in the use of the plane-table and theodolite, and 7 of them were taught levelling. Four of them obtained over 75 per cent. of marks in the examination prior to their final posting to field parties.

The instruction given in the training school consisted of plane-tabling on the 1-inch, 4-inch, 36-inch, and 100 feet to the inch scales, theodolite traversing both by chain and bar subtense, prismatic compass surveying, levelling with the dumpy level, model surveying, star observations for time and azimuth, drawing of scales, graphical projections and hand-printing.

The four recorders of No. 24 Party were sent down in September and received instructions in drawing scales, printing, drawing and graticule projecting, also in prismatic reconnaissance with pacing, and interpolation and intersecting with the plane-table. One sub-surveyor of No. 18 Party was instructed in levelling.

The following changes took place in the *personnel* of the Office during the year : Mr. J. Eccles, M.A., Superintendent, 2nd grade, returned from furlough and took over charge of the Computing Party on the 22nd November from Mr. H. W. Peychers, Extra Assistant Superintendent, 1st grade. Mr. Peychers retired on superannuation pension from 14th December. Mr. W. A. Fielding, Extra Assistant Superintendent, 6th grade, was transferred from No. 18 Party from 4th November to take charge of the training school. Mr. J. S. Manuel, Zincographer, who was absent on sick leave, retired on invalid gratuity from 19th February, and Mr. G. A. LeFranc officiated as Zincographer. Munshi Zakiruddin, Sub-surveyor, was transferred from No. 15 Party to the training school on the 1st November. Babu Umbica Churn Shome, Computer, retired on pension from 2nd July, and Babu Karuna Kumar Das was appointed as Copyist in the Computing Section.

The cost of the Computing Section under its various class heads and the percentage thereof, together with those of the three preceding years, are given in the following statement :—

CLASS.	COST IN RUPEES	PERCENTAGE OF COST.			
	1897-98	1897-98	1896-97	1895-96	1894-95.
1. Records, Library	994	3·6	3·0	2·9	3·4
2. Accounts, Returns, Correspondence	1,964	7·2	6·4	5·2	8·1
Carried over	2,958	10·8	9·4	8·1	11·5

Class.	Cost in Rupees.	Percentage of cost.			
	1897-98.	1897-98.	1896-97.	1895-96.	1894-95.
Brought forward	2,958	10·8	9·4	8·1	11·5
3. Supply of data, etc.	1,796	6·6	0·8	1·7	2·7
4. Computations	3,018				
5. Preparation of Press copy	5,254	67·9	79·9	78·5	5·8
6. Examination of Press proofs	10,194				
7. Ditto of charts	403	1·5	1·9	2·9	1·4
8. Protection of stations	1,096	4·0	3·4	3·3	2·2
9. Miscellaneous	1,359	5·0	3·2	4·4	4·3
10. Meteorology, etc.	1,158	4·2	1·4	1·1	1·9
11. Extra-Departmental work	...	...	...	...	0·2
Total	27,236	100	100	100	100

From the above table it will be seen that the working power of this section has been distributed much in the same way as in the preceding years, except that an unusually large percentage appears against the 3rd class owing to the great demand made on the section by a requisition from Professor Helmert of the International Geodetic Association; and class 10 shows an enhanced percentage owing to the deputation of four computers to assist in the eclipse observations at Pulgáon.

The following is an account of the work done under the several classes shown in the foregoing table:—

Class 1.—Records, Library, etc.—Seven fresh instalments of field records were received during the year; these together with those already in the office have received the usual care and attention. The three standard copies of the library catalogue have been kept up to date.

Class 2.—Accounts, Returns and Correspondence.—In this is included the preparation of indents, estimates, monthly detailed and abstract progress reports, annual reports, stock returns of office stores, and various other items.

Class 3.—Supply of data.—Nineteen requisitions for data and 49 indents for forms were received and complied with, in all about 36,000 copies of professional and other forms were issued during the year.

Class 4.—Computations.—The following are the details:—

Revision of heights of principal triangulation of the Bilâspur Meridional Series.—This revision was necessitated by the extension of lines of spirit levels across this series which shewed sensible discrepancies in the published values.

Burma Coast Series, Section 11° to 23°.—Examination of certain angle books in regard to the observations for azimuth, and computations of azimuths observed at three stations completed; and errors in log sides of certain triangles ascertained.

Mandalay Meridional Series.—Reduction of azimuth observations partly examined.

New net work Triangulation of Country round Dehra for the Training School.—Reduction completed.

Revisionary observations in Assam.—This revision was necessitated to ascertain what changes might have been caused by the earthquake of June 1897. A preliminary reduction of the observations was made in the Computing office, as soon as they were sent in from the field, so as to ascertain, as early as possible, the results obtained.

Hand-Book of Professional Instructions for the Trigonometrical Branch.—Revision of certain tables completed.

Tables for Determining Heights in Traversing.—Computations completed and tables prepared.

Captain Burton's Explorations in Persia, 1897.—Barometric heights computed.

Captain Deasy's Explorations in Tibet, 1897-98.—Computations being proceeded with and about two-thirds of the work done. The work includes the computations of astronomical azimuths, latitudes and time, geodetic latitudes, longitudes and azimuths, and triangles.

In addition to the above the computers were employed on the following:—

(*a*) Determining the probable error between the old and new values of Captain Lenox-Conyngham's determination of the longitude of Teheran.

(*b*) Preparing a table to show errors obtainable by working with rectangular co-ordinates.

(*c*) Reducing experimental observations by an explorer.

(*d*) Examining star chart for the Total Solar Eclipse of 22nd January 1898.

CLASS 5.—PREPARATION OF PRESS COPY.—This requires the abstracting and entering in suitable tables of the final results of several calculations for publication, all these compilations are twice compared, once against the original field records and once against the final computations, prior to being sent to the press. The details of the work done are as follows:—

(*a*) *Indus Delta Secondary Triangulation.*—Final revision of the co-ordinate list as regards orthography and description of stations completed.

(*b*) *Jubbulpore Meridional and Bilâspur Meridional Series.*—Revised heights abstracted.

(*c*) *Net work Triangulation of Country round Dehra-Dûn for the Training School.*—An abstract of rectangular co-ordinates and heights of points prepared.

CLASS 6.—EXAMINATION OF PRESS PROOFS.—This requires the utmost care and attention in comparison and examination in the several stages of first, second and form proofs. Most of the matter printed is numerical, or depending on numerical data, hence it necessarily involves a strictly critical examination which can only be given by men specially trained to this style of work. The printing of the following has been proceeded with:—

Sixteen pages of the Tidal Volume were examined and printed off; 80 pages of the Synoptical Volumes of the Indus Delta Triangulation and the Great Arc Meridional Series, Section 8° to 18° were also printed off. The printing of these volumes, both professional and synoptical, is nearing completion. About 64,000 copies of professional and other forms were printed. The total amount of work executed will be seen by reference to the tabular statement of the Printing Section.

CLASS 7.—EXAMINATION OF CHARTS.—Comparison and examination of the following completed:—

Preliminary Chart of Secondary Triangulation, Thayetmyo *viâ* Prome, etc. Seasons 1875-76 and 1879-81.

Preliminary Chart of Assam Longitudinal Series, Seasons 1853-55.

Four final charts of the Great Arc Meridional Series, section 8° to 18°, and two of the Indus Delta Triangulatian are in hand.

CLASS 8.—PROTECTION OF STATIONS.—The usual professional work in connection with the protection of survey stations and certain of the bench marks in the North-Western Provinces and Bengal was performed. During the year 547 stations have been repaired by the District Officers at a cost of R1,863-4-4, six districts out of 347, from which reports are generally received, failed to submit them.

CLASS 9.—MISCELLANEOUS.—In this are included various duties which cannot be fairly assigned to any of the other classes such as the following:—

(*a*) The examination and despatch of the printed papers to the Survey of India Office, Calcutta, for safe custody.

(*b*) The examination of all bound volumes and pamphlets prior to issue, and the preparation of the distribution lists and presentation labels for the same.

(*c*) The preparation of examination papers for the Provincial Service of the Survey of India Department of which 39 sets were prepared, despatched and examined the results being tabulated and submitted to the Surveyor-General.

CLASS 10.—METEOROLOGY AND GENERAL SCIENCE.—As hitherto a complete set of meteorological observations was taken daily throughout the year, and monthly and annual abstracts prepared. Monthly magnetic observations were also taken regularly throughout the year, and the results are tabulated with those taken here previously. The meteorological and magnetic results are given in the following tabular statements:—

Mean monthly Readings of Earth Thermometers.

Depth in feet of thermometer bulbs below surface of ground.	Year.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July	August.	September.
25·6	1897-98	77·13	77·34	77·25	76·97	76·57	75·95	75·39	74·91	74·91	75·22	76·70	78·48
	Mean, 1881—97	76·81	76·85	76·66	76·09	75·55	74·94	74·37	74·08	74·03	74·36	75·60	76·57
12·8	1897-98	79·61	78·84	77·38	75·20	73·51	71·99	72·21	74·30	76·28	78·36	79·91	80·03
	Mean, 1881—97	79·43	78·08	75·88	73·31	71·60	70·74	71·33	73·11	75·22	77·21	79·14	79·70
6·4	1897-98	80·44	77·38	72·97	69·12	67·59	67·05	73·04	78·66	81·62	82·07	81·63	80·36
	Mean, 1881—97	79·71	75·82	71·21	67·25	65·54	67·13	71·50	76·79	80·25	81·34	81·45	81·23
3·2	1897-98	79·58	73·96	67·07	64·20	62·82	66·78	79·18	84·21	85·93	83·23	81·74	80·78
	Mean, 1881—97	78·19	71·75	65·59	61·91	61·28	66·73	75·43	82·12	84·72	83·41	82·08	81·75
1·1	1897-98	78·56	70·64	60·95	59·99	59·68	67·77	82·30	87·65	89·04	83·61	81·43	80·11
	Mean, 1881—97	76·17	67·64	60·16	57·36	58·66	67·62	78·67	86·08	87·81	84·22	82·34	81·65
Thermometer in shade	1897-98	81·37	73·83	66·85	68·53	64·73	79·98	93·20	92·11	89·44	81·91	79·68	81·10
	Mean, 1881—97	80·54	73·36	67·68	64·13	66·99	78·50	89·75	93·93	90·10	82·54	80·66	82·53

Mean velocity in miles of the Winds which blew at Dehra Dún during the twelve months of 1897-98 for each hour of the day.

Civil Hours.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	Mean.
0 to 1 . . .	0·81	1·10	0·87	1·30	1·04	1·57	1·90	1·97	0·50	0·58	0·42	0·62	1·05
1 „ 2 . . .	0·71	0·93	0·65	1·50	1·04	1·33	2·03	1·38	0·67	0·61	0·39	0·76	1·01
2 „ 3 . . .	0·26	0·73	0·39	1·13	0·96	1·03	1·34	1·61	0·83	0·55	0·19	0·69	1·81
3 „ 4 . . .	0·23	0·50	0·45	0·63	1·04	0·93	1·38	1·00	0·87	0·65	0·23	0·52	0·70
4 „ 5 . . .	0·43	0·37	0·42	0·70	1·00	0·97	1·17	0·90	0·87	0·39	0·26	0·59	0·65
5 „ 6 . . .	0·29	0·27	0·29	0·53	0·86	0·70	0·83	0·97	0·87	0·42	0·19	0·59	0·57
6 „ 7 . . .	0·19	0·47	0·19	0·50	0·95	0·70	0·72	1·00	0·63	0·53	0·85	0·65	0·57
7 „ 8 . . .	0·06	0·40	0·19	0·50	0·71	0·67	0·52	0·64	1·10	0·63	0·55	0·69	0·55
8 „ 9 . . .	0·16	0·07	0·23	0·43	0·89	0·87	0·67	1·58	1·60	0·97	0·97	0·76	0·77
9 „ 10 . . .	0·26	0·33	0·39	0·73	1·18	1·53	1·40	2·23	2·47	1·35	1·10	1·03	1·17
10 „ 11 . . .	0·71	0·93	0·87	1·52	1·54	2·19	2·00	2·52	2·53	1·61	1·84	1·43	1·64
11 „ 12 . . .	1·13	1·23	1·71	2·29	2·25	2·77	3·53	2·65	2·53	1·71	1·87	1·83	2·12
12 „ 13 . . .	1·23	1·27	1·77	2·13	2·93	3·55	3·93	3·55	2·50	2·13	2·13	1·31	2·17
13 „ 14 . . .	1·42	1·53	1·87	2·70	3·07	3·84	4·00	4·48	3·07	2·10	2·06	1·62	2·64
14 „ 15 . . .	1·68	1·30	1·65	3·23	3·29	4·55	4·24	4·77	2·90	2·35	1·94	1·76	2·80
15 „ 16 . . .	1·35	0·83	1·74	2·83	3·57	4·42	4·10	4·55	2·30	1·90	1·68	1·69	2·58
16 „ 17 . . .	0·87	0·47	1·10	1·93	3·29	4·10	5·38	4·15	1·93	1·26	1·00	1·14	2·24
17 „ 18 . . .	0·20	0·10	0·19	0·90	2·07	2·35	3·48	4·26	1·63	0·90	0·77	0·62	1·46
18 „ 19 . . .	0·29	0·27	0·29	0·50	1·00	0·71	1·03	2·48	1·47	0·74	0·45	0·66	1·82
19 „ 20 . . .	0·68	0·73	0·68	0·60	1·11	0·87	0·55	1·68	0·87	0·42	0·32	0·76	0·77
20 „ 21 . . .	0·87	1·13	1·03	1·26	1·18	1·19	1·10	1·29	1·17	0·32	0·32	0·76	0·97
21 „ 22 . . .	1·06	1·17	0·90	1·50	1·21	1·84	2·03	1·42	1·10	0·19	0·45	0·90	1·15
22 „ 23 . . .	0·94	1·20	0·97	1·43	1·36	1·97	2·41	2·10	1·23	0·35	0·29	0·93	1·26
23 „ 24 . . .	0·77	1·23	1·00	1·20	0·96	1·67	2·33	2·39	0·83	0·58	0·45	0·93	1·19
Sums . .	16·39	18·26	19·84	31·97	38·51	46·32	52·12	56·23	36·47	23·24	20·22	23·14	...
Average .	0·68	0·76	0·83	1·33	1·60	1·93	2·17	2·34	1·52	0·97	0·84	0·96	...

Monthly Meteorological Results of observations taken at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún.

Year and Month.	Barometer reduced to 32° Fah.						Hygrometer.		Thermometer.				Rain.		Wind.	Cloud.	
	At 10 A.M.			At 4 P.M.			10 A.M.	4 P.M.	Dry Bulb.			Wet Bulb.					
	Highest.	Lowest.	Monthly mean.	Highest.	Lowest.	Monthly mean.	Monthly mean humidity.	Monthly mean humidity.	Highest maximum in air.	Lowest minimum in air.	Monthly mean in air.	Lowest minimum.	Number of days it fell.	Fall in inches.	Most frequent direction.	At 10 A.M.	At 4 P.M.
1897.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	°	°	°	°	°	°					
October	27.816	27.476	27.668	27.732	27.415	27.587	52	49	86.8	54.1	1.6	49.8	...	...	Calm.	0.7	0.7
November	.900	.628	.784	.769	.589	.686	53	48	82.3	47.8	63.5	45.2	...	...	Calm & S.	0.5	1.3
December	.966	.675	.828	.863	.591	.739	54	47	72.8	40.4	55.0	37.0	1	0.07	Calm.	2.8	1.8
1898.																	
anuary	.969	.693	.805	.904	.597	.718	49	39	78.2	40.7	56.6	37.8	3	0.35	W. & Calm.	2.1	3.2
February	.829	.426	.674	.742	.370	.592	60	50	79.0	39.1	55.3	38.0	9	5.18	W.	3.6	5.3
March	.790	.517	.674	.688	.412	.586	37	23	93.7	38.5	67.3	35.8	...	...	W. & S. W.	2.2	3.4
April	.783	.450	.581	.654	.361	.479	26	20	102.6	58.5	80.4	49.6	1	1.53	W.	0.8	1.8
May	.658	.365	.501	.576	.263	.400	29	21	102.2	60.8	81.4	51.9	5	0.63	S. W. & W.	3.9	4.2
June	.542	.212	.368	.443	.114	.272	64	55	100.1	68.7	83.0	63.8	13	8.31	S & S.E.	4.6	5.3
July	.506	.246	.395	.451	.167	.306	82	79	91.1	67.9	77.8	66.3	21	30.18	S. E.	7.2	7.8
August	.539	.248	.417	.463	.185	.333	86	84	88.3	69.5	76.6	68.2	28	47.87	S. E. & Calm.	8.2	8.7
September	.718	.420	.555	.628	.309	.460	76	72	87.8	61.1	74.7	58.4	13	23.17	S. E. & Calm.	5.3	5.0

Synopsis of the results of the Monthly Magnetic observations taken at the Trigonometrical Branch Office, Dehra Dún. The measures of Intensity are all expressed in C. G. S. units.

Year and Month.	Magnetic Elements: Declination East.	Magnetic Elements: Horizontal Intensity.	Magnetic Elements: Dip North.	Magnetic Elements: Total Intensity.	Remarks.
	° ′ ″		° ′		
1868.					
January	3 2 14	0·33,634	41 27·4	0·44,878	
February	—	·33,635	27·1	·44,875	
March	—	·33,656	25·2	·44,882	
April	—	·33,573	30·0	·44,826	
May	—	·33,569	33·0	·44,856	
June	—	·33,614	29·3	·44,873	
July	—	·33,685	34·0	·45,023	
August	—	·33,625	28·7	·44,880	
September	3 3 4	·33,608	32·5	·44,901	With unifilar magnetometer No. 16 and Dip circle No. 43.
October	3 2 13	·33,551	30·0	44,796	
November	—	·33,632	30·9	·44,915	
December	—	·33,616	35·0	·44,942	
1869					
January	—	0·33,643	41 32·2	0·44,946	
February	—	·33,636	31·3	·44,925	
March	—	·33,621	28·1	·44,868	
September	3 5 10	·33,466	35·4	·44,746	
November	3 6 44	·33,644	32·1	·44,946	
1897.					
January	2 49 39	0·33,659	42 40·2	0·45,778	
February	48 42	·33,730	42·1	·45,898	
April	48 17	·31,901*	41·0	·43,396*	
May	50 4	·33,667	46·5	·45,866	
June	48 15	·34,032	50·5	·46,413	
July	48 42	·33,646	38·8	·45,743	
August	45 22*	·33,056	45·6	·45,840	
September	48 10	·33,695	45·2	·45,888	
October	49 27	·33,639	46·2	·45,824	
November	50 33	·33,627	44·4	·45,786	With unifilar magnetometer No. 19 and Dip circle No. 43.
December	48 24	·33,667	48·0	·45,884	
1898.					
January	2 50 45	0·33,757	42 48·0	0·46,007	
February	50 1	·33,605	48·2	·45,802	
March	51 12	·33,665	46·8	·45,867	
April	50 32	·33,660	52·9	·45,936	
May	51 11	·33,842	51·9	·46,173	
June	51 14	·33,544	48·3	·45,721	
July	54 24	·33,271	52·1	·45,396	
August	48 24	·33,714	48·5	·45,955	
September	51 32	·33,569	52·8	·45,811	

* Observations unsatisfactory.

TYPE-PRINTING SECTION.—As will be seen from the annexed statement the greater part of the work done consisted in setting up the large number of headings, foot-notes, etc., required in the Drawing Section in connection with the publication of maps and miscellaneous work:—

Statement of work done during 1897-98.

SPECIFICATION OF PRINT.	No. of pages.	Total No. of pulls.	No. of copies of each page.	VALUE.
				R
Professional volume	44	5,490	500	1,647
Synoptical volume	80	8,670	350	1,992
Letter-press for charts, map headings, foot-notes	396	9,190	...	3,851
Forms	188	104,810	...	5,480
Eclipse Report	16	1,080	200	265
Miscellaneous	221	19,880	...	2,474
Extra-departmental work	191	8,300	...	150
	1,136*	157,420	...	15,859

*Equal to 1,597 pages of standard (foolscap) size.

The usual table showing the work annually performed by this section during the past five years is given below, the unit (a page of foolscap) being the same throughout:—

	1893-94	1894-95	1895-96	1896-9	1897-98
Pages composed	1,638	1,219	1,135	1,110	1,597

An analysis of the pages composed in 1897-98 is as follows:—

PROFESSIONAL VOLUME	Bidar Longitudial Series (Revision of heights) Great Arc Meridional Series, Section 18° to 24° (ditto) Tidal volume	76
SYNOPTICAL VOLUME	Great Arc Meridional Series, Section 8° to 18° and Indus Delta Triangulation.	120
MISCELLANEOUS	Letter-press for charts, map headings, foot-notes	536
	Forms, orders, memoranda, etc.	415
	Miscellaneous	254
	Extra-departmental work	172
	Eclipse Report	24
	TOTAL	1,597

PHOTO-ZINCOGRAPHIC SECTION.—The only change which has occurred in the working of this section is in the process employed for cleaning the glasses for negatives. The laborious method of polishing with tripoli powder has been discarded, and instead the glass is placed film and all in a solution of—

Bichromate of potash	5 oz.
Sulphuric acid	5 oz.
Water	100 oz.

and allowed to remain for 24 hours. On removal the film has generally completely peeled off. The glass is scrubbed on both sides with a hard brush and well washed in clean running water. It is then placed in a trough of clean water till such time as the photographer may be ready to apply the substratum which consists of—

Gelatine	22 grains.
Liquor ammonia	40 minims.
Water	20 oz.

This is applied to the wet plate, the first coating being run off and second applied. The plate is allowed to dry and put away for use next day. Negatives which have been varnished with a hard benzole or spirit varnish require to be soaked longer in the solution.

The following tables exhibit the value and outturn of the work done by this section:—

Abstract of departmental work done during the year 1897-98.

Specification.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic Printing. Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Pulls.	Number of copies. Coloured.	Uncoloured.	Total.	Silver and other Printing. Silver prints.	Blue and other prints.	Value. R	a.
Standard maps	209	389	461	210	256	31,547	4,085	23,405	27,490	...	...	14,133	15
Index maps	6	2	8	6	14	2,434	1,145	127	1,272	...	...	189	13
Technical charts	8	19	19	8	8	500	...	500	500	...	...	416	10
Miscellaneous maps, plans, etc.	214	99	109	66	130	10,682	686	9,824	10,510	32	115	3,151	9
Departmental forms	1	1	1	1	1	200	...	100	100	...	...	37	10
Transfers and proofs	...	...	...	...	...	1,164	...	...	...	...	...	...	
Totals	438	510	598	291	409	46,527	5,916	33,956	39,872	32	115	17,929	9

Statement of work done for other departments, etc., during the year 1897-98.

Departments, etc.	Sheets or subjects.	Negatives and transparencies.	Photo-zincographic Printing. Photo-transfer prints.	Zinc plates transferred.	Zinc plates printed.	Pulls.	Number of copies. Coloured.	Uncoloured.	Total.	Silver and other Printing. Silver prints.	Blue and other prints.	Value. R	a.
Forest Survey	125	194	209	132	133	17,861	1,400	12,696	14,096	...	...	6,091	3
Engineer-in-Chief, Hardwár-Debra Railway	7	4	4	2	2	200	...	700	700	...	...	71	0
Totals	132	198	213	134	135	18,061	1,400	13,396	14,796	...	...	6,162	3

Table showing the amount realised from other departments, etc., by book debit and cash sales during 1897-98.

Departments, etc.	By book debit. R	a.	By cash sales. R	a.	Total. R	a.
Forest Department	63	4	240	14	304	2
Forest Survey	6,253	0	386	2	6,639	2
Quarter Master General	12,297	13	88	5	* 12,386	2
Military Department	......		176	14	176	14
Other Departments	114	9	566	3	680	12
Private individuals	......		133	7	133	7
Totals	18,728	10	1,591	13	20,320	7

* The greater portion of this sum was for work completed in 1896-97, but the adjustment was not made in time to permit of its being shown in last year's report.

CORRESPONDENCE SECTION.—The work in this section has been carried on as usual

STORES, WORKSHOPS AND OBSERVATORIES SECTION.—An astronomical equipment was cleaned and taken to the solar eclipse camp at Sahdol. The instruments returned by the survey officers with the Tirah Expeditionary Field Force were cleaned and stored, while some alterations in the instruments of the astronomical parties were successfully carried out. In the observatories, the usual time observations were taken, the chronometers rated and kept in order and other miscellaneous work done.

SOLAR PHOTOGRAPHIC SECTION.—The work of this section was conducted as usual; experiments with dry plates were continued and fairly successful results were obtained. The 12-inch instrument was also put in working order.

he details of the work of this section are given below :—

Table showing the number and character of negatives.

1897-98.	Number of days.				Number of Negatives.										Number of working days when Phenomena were	
	When negatives were taken.	Failures.			Solar Phenomena.								Total.			
		From bad weather.	From various causes.	Total.	Spots and faculæ.		Spots only.		Faculæ only.		None.				Visible.	Absent.
					8"	12"	8"	12"	8"	12"	8"	12"	8"	12"		
October . .	31	...	...	31	37	...	...	...	20	...	...	...	57	...	31	...
November . .	30	...	...	30	44	...	...	...	11	...	...	...	55	...	30	...
December . .	30	1	...	31	50	...	...	...	4	...	...	...	54	...	30	...
January . .	28	3	...	31	52	...	...	...	...	...	...	...	52	...	28	...
February . .	21	7	...	28	34	...	...	...	6	...	...	...	40	...	21	...
March . .	29	2	...	31	38	...	...	...	12	...	...	...	50	...	29	...
April . .	29	1	...	30	39	...	...	...	15	...	...	...	54	...	29	...
May . .	31	...	...	31	54	...	...	...	2	...	...	...	56	...	31	...
June . .	26	4	...	30	34	...	...	...	12	...	...	...	46	...	26	...
July . .	23	8	...	31	20	...	...	...	19	...	...	...	39	...	23	...
August . .	21	10	...	31	31	1	...	...	1	...	...	...	32	1	21	...
September . .	26	4	...	30	43	3	...	...	...	...	...	...	43	3	26	...
TOTAL .	325	40	...	365	476	4	...	...	102	...	...	...	578	4	325	...

Five hundred and thirteen silver prints of the 8-inch pictures, and four of 12-inch pictures were prepared, and weekly despatches of both silver prints and negatives made as usual to the India Office.

Table showing the visibility of Sun at Dehra Dún and Greenwich.

Year.	At Dehra Dún.			At Greenwich.		Remarks.
	Number of days on which negatives were taken.	Percentage of days on which negatives showed features.	Number of days on which sun was invisible.	Year.	Number of days on which negatives were taken.	
1880-81*	307	96	55	1880	156	* From 1st October to 30th September following.
1881-82	328	100	37	1881	181	
1882-83	318	100	47	1882	221	
1883-84	285	100	78	1883	215	
1884-85	284	100	81	1884	154	
1885-86	290	100	75	1885	206	
1886-87	302	91	61	1886	199	
1887-88	328	71	38	1887	188	
1888-89	315	78	50	1887-88	205	
1889-90	320	99	45	1888-89	182	
1890-91	303	100	62	1889-90	212	
1891-92	304	100	62	1890-91	224	
1892-93	292	100	73	1891-92	219	
1893-94	304	100	61	1892-93	220	
1894-95	312	100	52	1893-94	230	
1895-96	324	100	41	1894-95	199	
1896-97	316	100	49	1895-96†	229	† Year ending 10th May 1896 obtained from the report to the Board of Visitors.
1897-98	325	100	40	1896-97	Not obtainable.	
Mean	309	...	56	...	202	

DRAWING SECTION.—The details of the work of this section are given below :—

Statement showing the work performed during 1897-98.

Title of Map.	Number of sheets.	Scale.	REMARKS.
General Maps.		In M.	
North-Eastern Frontier sheet No. $\frac{5-12}{6-13}$.	1	1=16	Completed. Final press order given.
Map of Persia, 1897	6	1=16	Ditto ditto.
Standard Maps.			
North-Western Provinces, Dehra Dún and Siwáliks (2nd edition) . . .	4	1=1	Corrections completed. Final press order given.
Central Provinces Survey sheet No. 8 $\frac{\text{N. E.}}{4}$	1	1=¼	Boundaries corrected. Final press order given.
Punjab Survey Sheets Nos. 265 N.W., 265 S.W., 285 S.E., 286 S.W., 289 N.E., 289 S.E., 311 S.W., 312 S.E. and 313 N.E.	36	1=½	Corrections completed for reduction to half scale. Final press order given.
Punjab Survey Sheets Nos. 264 N.E., 264 S.W., 307 S.W., 308 N.W., 313 N.W., 313 S.W. and 336 N.W. . .	28	1=½	Corrections for reduction to half scale. In hand.
Plans of Cities and Cantonments.		In. Ft.	
Karáchi City, Layári Quarter, Sheets Nos. 1 to 18	18	1=80	Touched up for Photography. Final press order given.
Index Maps.		In. M.	
Triangulation Chart of India . . .	1	1=96	Corrected and brought up to date for Annual Report.
Index to illustrate survey operations by No. 18 Party in the Himálayas . .	1	1=20	Ditto ditto.
Index to illustrate survey operations by Nos. 12 and 15 Parties in Sind . .	1	1=50	Ditto ditto.
Charts.			
Triangulation Chart of Great Arc Series, Sections 8° to 18°	4	1=4	In hand.
Nos. 43 and 44, Preliminary Charts of Indus Delta Coast Triangulation . .	2	1=4	In hand.
Chart of Triangulation Sheets Nos. 1, 5, 6 and 7 (Central Provinces) . . .	4	1=1	For reduction to half scale. Completed headings and footnotes. Final press order given.
Chart of Triangulation Sheets Nos. 8, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19, 20, 23, 24, 25, 26, 27, 28, 34, 35, 36, 37, 38, 39, 63, 64, 82, 83 and 84 (Central Provinces)	29	1=1	For reduction to half scale. In hand.
Chart of Triangulation Sheet No. 17 (Sind Survey)	1	1=1	For reduction to half scale. Corrected. Headings and footnotes completed. Final press order given.
Chart of Triangulation Sheets Nos. 15, 16, 32, 33, 34, 47, 48, 66, 67, 68, 87, 88, 89, 108 and 109 (Sind Survey) . . .	15	1=1	For reduction to half scale. Corrections in hand.
Triangulation Chart of Dehra Dún Survey	1	1=½	In hand.
Chart of Triangulation Sheet No. 332 (Punjab Survey)	1	1=1	For reduction to half scale. In hand.
Level Charts Nos. 67 and 74	2	1=2	Compilation in hand.
Level Chart No. 88	1	1=2	Completed. Final press order given.

Statement showing the work performed during 1897-98—concld.

Title of Map.	Number of sheets.	Scale.	REMARKS.
Miscellaneous.	In. M.		
Tidal Maps of Tuticorin, Galle, Amherst, Minicoy, Rangoon, Pámban Pass, Dublat, Hansthal Point and Diamond Harbour	9	Various	Completed. Final press order given.
Tidal Maps of Bhávnagar, Bombay and Moulmein	3	Various	In hand.
Other maps'	14	Various	Touched up for photography and completed as regards headings and footnotes. Final press order given.
Maps coloured	3,383	Various	

MAPS EXAMINED.

Standard original maps	130
Charts	16
Miscellaneous maps	21
Photographic proofs of Standard sheets and other maps	290
TOTAL .	457

N.B.—In addition to the above other miscellaneous duties have been performed, such as correcting and completing the Standard sheets and Triangulation Charts of the Central Provinces, Punjab, and Sind Surveys in respect of headings, foot-notes, symbols, etc., for press; taking out and checking areas of villages with their cultivation in the Punjab Survey sheets and incorporating the Indus Riverain Survey on the Sind Survey sheets. Preparing descriptive diagrams of the Pentagraph and Planimeter with specimens of hill shading and printing for the Survey Training School and diagrams, sketches and charts for the Solar Eclipse Report; examination of and custody of records, making all the despatches of maps, etc., etc., etc.

Statement of work done for other departments during 1897-98.

TITLE OF MAP.	Number of sheets.	Scale.	REMARKS.
		In. M.	
Standard Maps.			
Forest Surveys	88	4 = 1	Completed headings, foot-notes and references. Final press order given for Forest Department.
Ditto	1	1 = 1	Ditto ditto.
Index Maps.			
Forest Surveys	7	Various.	Ditto ditto.
Miscellaneous.			
Forest Surveys	17	Various.	Ditto ditto.

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G. I. C. P. O.—No. 16 S. G.—26-5-99.—450.

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GOVERNMENT OF INDIA.

DEPARTMENT OF REVENUE AND AGRICULTURE.

File No. 89 of 1899.

Serial No. 2.

LAND SURVEYS.

RESOLUTION.

No. 3—89-2.

Dated Simla, the 8th July 1899.

SUBJECT.

General Report on the Operations of the Survey of India Department during 1897-98.

G. C. Press, Simla.—No. 354 R. & A. D—11-7-99.—680.

(Extract from the Proceedings of the Government of India, Department of Revenue and Agriculture, No. 3—89-2, dated 8th July 1899).

READ—

The General Report on the Operations of the Survey of India Department during the year 1897-98.

RESOLUTION.

The field operations of the Survey of India Department during the year ending 30th September 1898 were carried on by two double and seventeen ordinary parties.

The various classes of work on which these parties were engaged were as follows :—

	Number of parties employed.	Number of detachments employed.
1. Trigonometrical	1	1
2. Topographical	7	...
3. Forest (excluding the Forest Survey Branch) ...	3 (1 double)	...
4. Cadastral	3	...
5. Traverse	2 (1 double)	...
6. Scientific	3	...
TOTAL ...	19 (2 double)	1

Thus 6 single and 2 double parties were employed on traverse, cadastral and forest surveys, as compared with ten whole parties and two detachments so employed in 1896-97.

2. The total area surveyed on all scales during the year, excluding reconnaissance surveys, was 26,223 miles against 26,269 in the previous year.

3. The party employed on trigonometrical operations undertook the work of continuing the Makran Longitudinal series westwards. It was however attacked, 17 lives were lost, much personal and public property was plundered, and work was brought to an abrupt conclusion.

4. Topographical operations were carried on in the Shan States of Upper Burma, Sindh, Lushai Hills and the Himalayas. To meet the requirements of the Irrigation Department a survey of certain lands in Kalat was undertaken *pari passu* with the work in Sindh, the area topographically surveyed amounting to 1,477 square miles. The topographical survey of the Lushai Hills was

begun during the season and in addition to the triangulation of 1,300 square miles, a secondary series of triangles was started from one of the sides of the eastern frontier series. The topography of Mandi, Suket and the Simla Hill States was also continued. The total area topographically surveyed during the year amounted to 15,109 square miles against 14,460 square miles in the year 1896-97.

5. Forest surveys were conducted by the Imperial parties in Madras, Bombay, Burma and the Himalayas. In the Madras Presidency two full parties were employed, but, owing to unforeseen difficulties, the expected increase in the area of detail survey completed was not realised. In the Bombay Presidency an area of 677 square miles was surveyed on three different scales; while the outturn in Lower Burma consisted of 406 square miles on the 4-inch scale in the Pegu and Shwegyin Divisions and 118 square miles on the 2-inch scale on the Yenwe river. The Himalaya party completed 146 square miles in Sirmur, Kulu and Kangra.

The Forest Survey Branch continued its operations in Oudh, Punjab, Burma and the Central Provinces. The outturn of work of the Imperial parties and the Forest Survey Branch for the past two years is given below :—

	1896-97. Sqr. miles.	1897-98. Sqr. miles.
(1) Imperial parties	3,260	2,397
(2) Forest Survey Branch	1,563	1,737
	4,823	4,134

The decrease in area surveyed by the Imperial parties was due to the conversion of No. 14 party, hitherto employed on forest surveys, into a topographical party.

The cost rate of the 4-inch work in Bombay has been reduced, but that of the 8-inch survey was higher than in the previous year, owing to the difficult nature of the country in Nasik and Kolaba and to casualties amongst the trained men and experienced surveyors from plague. The cost rate of the detailed survey as far as executed by the Survey of India Department in Burma continued to be high owing to the entertainment of a large number of new men, inexperienced in forest surveys. The early commencement of the monsoon and excessive sickness also affected the cost rate.

6. Cadastral operations (Imperial) were carried on by one party in Bengal, two parties in Burma and by local agency in the North-Western Provinces and Oudh under the Superintendent of Land Records Survey. The programme of surveys in Bengal consisted of operations in the Saran, Darbhanga and Noakhali districts and the re-demarcation of the boundary between Nepal and the districts of Purnea and Bhagalpur. In the North-Western Provinces and Oudh record writing in Meerut and Lalitpur was completed, whilst in Shajehanpur and Bahraich the surveys and writing of records were both finished. Survey and record operations were begun in Bijnor, Bareilly, Kheri and Gonda. In Burma the survey of the Minbu District and the traversing of the Toungoo District were completed, whilst the survey of the Lower Chindwin was begun. A special survey of the Rangoon Sadar Bazar was also undertaken at the request of the

Cantonment authorities. The total area cadastrally surveyed in the three provinces was 6,976 square miles against 7,190 square miles in the previous year.

7. One double party was engaged on traverse operations in the North-Western Provinces and Oudh and one single party in Assam. The total area traversed was 5,128 square miles compared with 6,135 square miles in the preceding year.

8. The system of determining latitudes by observing at groups of stations close together instead of at a single station was given a trial during the year, and although the experiment was not entirely successful, interesting results were obtained.

9. Tidal observations with the self-registering tide-gauges were made at 13 stations in India, Burma, the Persian Gulf, the Andaman Islands and the Red Sea. Personal tidal observations to graduated staves were also taken at six stations to compare the actual times and heights of high and low water with those predicted in the Tide Tables.

A detachment of the Tidal and Levelling party undertook the revision of the principal triangulations in the Khasi and Garo Hills with a view to ascertain what displacement vertically or horizontally had taken place during the earthquake of June 1897. The result shows that the stations observed lay within the area affected by the earthquake, and that all of them have suffered more or less within a range of a few feet, the general apparent effect being that the area has been both widened and raised.

Considerable assistance was also afforded to the English Astronomers in the observation of the total eclipse of the sun which occurred on January 22nd, 1898.

10. In Upper Burma an area of 1,752 square miles of new country was geographically surveyed. The aggregate area geographically surveyed on the Eastern and Western Frontiers amounted to 9,976 square miles.

11. The work done in the various head-quarters offices was satisfactory. The Drawing Section continued to make progress in the completion of the maps of the North-Eastern and South-Eastern Frontiers. The third edition of the map of India on the 32-mile scale was completed, whilst a new canal map and a railway map on the same scale was published and a railway map showing railway and steamer stations was put in hand. The revision of district maps was continued, seventy-seven of the Atlas sheets were completed and brought up to date, and a large number of maps were executed in connection with the famine in Bengal and the Central Provinces as well as for the Military and other Departments. The total number of cadastral sheets published was 4,731.

12. In the Engraving Office considerable progress was made in the preparation of the quarter sheets of the Atlas of India, 16 maps for administration reports were published, and 21 District maps and various other maps, charts and plans were in hand in different stages of progress. The provincial map on the 16-mile scale of Gujarat was issued, whilst those of Bengal, Bombay, Madras, Rajputana, Punjab, and Kashmir had new material added to them. The outturn of work in the Printing Section of this office was more than in the preceding year.

13. The total value of the work done by the Photographic and Lithographic offices was Rs. 1,92,927 against Rs. 2,13,518 in the previous year, the

amount of work received for reproduction being somewhat less than usual. The principal item of extra-departmental work done was the illustration with 29 maps and diagrams of the plague reports issued by the Home Department. In the Heliogravure Section, in addition to regular work, some useful experiments were made in trichromatic photography and in electro-deposition for the correction of hand-engraved copper plates.

14. The total number of maps issued from the Map, Record and Issue Office was 156,523 and their value Rs. 1,17,942, a decrease of 50,807 in number and Rs. 39,985 in value on the figures of the previous year.

15. There was an increase of 8,373 in the number and Rs. 2,411 in the value of the instruments issued by the Mathematical Instrument Office. There was also an increase in the value, though a decrease in the number, of the instruments received and made serviceable by that office. Since the increased establishment for the repair of instruments was sanctioned, 416 levels and 107 theodolites have been converted and issued, and all indents for such instruments have been discontinued. The value of instruments indented for during 1898-99 was £4,823, a slight increase over the figure of the year immediately preceding, but considerably less than the figures of former years.

16. The Government of India have noticed with satisfaction that the Training School at Dehra has justified its institution. Seventeen pupils were under instruction, during the year, all of whom passed the examination at the end of the course. Six newly appointed Provincial Officers also went through a course of training and were all pronounced thoroughly fit for field work at its completion.

17. The Survey of India Department lost during the year the services of two distinguished officers by the retirement of Colonel J. E. Sandeman, I.S.C., Deputy Surveyor General in charge Revenue Branch, and Colonel Sir T. H. Holdich, K.C.I.E., C.B., R.E., and by the death of Major-General R. G. Woodthorpe, C.B., R.E., the Government of India were deprived of another most valuable and distinguished officer. The Department remained throughout the year under the administration of Major-General C. Strahan, R.E., and the Government of India desire to acknowledge the energy and success with which he has maintained the efficiency of the Department, and the value of the work carried out in the various branches.

ORDER.—Ordered that the above Resolution be forwarded to the Surveyor General of India, the Inspector General of Forests, the Local Governments and Administrations noted on the margin, and to the Foreign, Military and Public Works Departments.

Madras.
Bombay.
Bengal.
North-Western Provinces and Oudh.
Punjab.
Burma.
Central Provinces.
Assam.
Coorg.
Berar.

Ordered also that the Resolution be published in the Supplement to the *Gazette of India.*

[True Extract.]

M. FINUCANE,

Offg. Secretary to the Government of India.


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